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USSR Report

MATERIALS SCIENCE AND METALLURGY

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19 March 1980

USSR REPORT

MATERIALS SCIENCE AND METALLURGY

No. 67

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USSR UDC 620.172.251.2.05-426

DEVICES FOR TESTING THIN FIBERS AND WIRE FOR HEAT RESISTANCE

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 45, No 11, Nov 79 pp 1055-1057 manuscript received 4 Oct 78

KOSAREV, A.I., KOSAREV, YE.A. and NEYMAN, S.M.

[Abstract] Two special devices have been built with which thin fibers made of inorganic materials and thin wire made of a refractory metal can be tested for heat resistance. The first device is intended for high-temperature tests in air or in an inert atmosphere. It consists essentially of a cylindrical guide rod with a tensile loading mechanism and a beaker inside a vertical tubular furnace. It is designed for simultaneous testing of several specimens in different atmospheres at the same temperature and under the same or different tensions. The second device is intended for testing under vacuum and represents an appropriately modified tensile testing machine with a crossarm and clamps installed, after assembly, inside a vacuum test chamber. Both devices are built with heat resistant materials. They have been used for measuring the life-stress characteristics of SiC fibers 0.08-0.1 mm in diameter (at 1023-1123°K in air) and of tungsten wire 0.1 mm in diameter (at 1373°K under 10^{-4}-10^{-5} mm Hg) respectively. Figures 4; references 1 Russian.
[83-2415]

USSR UDC 539.4+666

CONCERNING THE ACCURACY OF PROCESSING RESULTS OF CERAMIC BEND TESTS

Kiev PROBLEMY PROCHNOSTI in Russian No 10, Oct 79 pp 51-54 manuscript
# received 26 Jul 78

GRUSHEVSKIY, YA. L., Kiev, Institute of Problems of Strength, Academy of Sciences UKrSSR

[Abstract] A method is described for approximating and differentiating load-strain curves which can be used to determine the bend strength of ceramics with consideration of the non-linearity of deformation curves and the differences in the mechanical behavior of materials under tension and compression. Alumina + titanium oxide, alumina + zirconium silicate, zirconium oxide + hydrogen phosphate + calcium oxide and carborundum refractory M7 were used as subject materials to determine the strain derivative E'. The algorithm for performing the above is discussed and

the mathematics developed. It was found that neglecting the nonlinearity of the strain diagram and differences in the deformation of these ceramics leads to errors that are 2-3 times greater than for the generally accepted method. Figures 4; references 6: all Russian.
[57-6368]

USSR UDC 669.1.017:669.018.29

COMPOSITE MATERIAL WITH A MATRIX OF HIGH-CHROMIUM IRON

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11 Nov 79 pp 6-8

PONOMARENKO, V. P., STOYKO, V. P. and SHVARTSER, A. YA., Donets Polytechnical Institute

[Abstract] A technology for introducing reinforcing particles into a high-chromium iron matrix developed by the authors uses electroslag surfacing to distribute the particles close to the matrix surface for improved wear resistance. Rhelite [$WC+W_2C$ eutectic] grains were used as the reinforcing particles. A study was made of the interaction of the particles with the matrix to determine the effect on matrix structure and hardness. Complex W and Cr carbides were formed by interaction of the matrix and reinforcing particles which in turn formed eutectic and hypoeutectic structures. A carbide shell formed around each reinforcing grain, providing very high microhardness. As the distance from the shell increased, microhardness diminished but strength increased. Therefore, if the reinforcing particles are positioned uniformly at specific distances from each other, the composite material will have high hardness for wear resistance and sufficient strength to sustain shocks during operation. Figures 3; references 2: both Russian.
[55-6368]

USSR UDC: 678.5.06:678.2

INFLUENCE OF HEAT TREATMENT OF THE MATRIX ON THE MECHANICAL PROPERTIES OF CARBON-REINFORCED PLASTIC

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 5, Sep/Oct 79 pp 925-929, manuscript received 15 Mar 79

ZHIGUN, I. G., MOROZOV, O. A., RADIMOV, N. P., Institute of Polymer Mechanics, Academy of Sciences Latvian SSR, Riga; All-Union Scientific Research Institute of Artifical Fibers, Moscow Oblast

[Abstract] A study is made of a method of improving the shear properties and tensile and compressive strength of carbon-reinforced plastic in the direction transverse to the unidirectional reinforcing filaments by creation of rigid coupling between the reinforcing fibers. These couplings were formed by heat treatment of the polymer matrix, type 5-211B epoxy-phenyl

binder or phenyl-formaldehyde binder, reinforced with LU-3 strips. The process includes the following main operations: production of the initial carbon-reinforced plastic; heat treatment of the binder; saturation of the material with binder under a vacuum and under pressure after heat treatment with subsequent curing. Figures 5; references 7: all Russian.
[39-6508]

USSR UDC: 539.43:678.5.06

LONG-TERM FAILURE OF INELASTIC COMPOSITES

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 5, Sep/Oct 79 pp 794-798, manuscript received 2 Feb 79

SUVOROVA, YU. V., VIKTOROVA, I. V., MASHINSKAYA, G. P., Moscow

[Abstract] A model developed earlier is used to show how irreversibility, appearing in the deformation of composites, may be related to gradual accumulation of damage occurring upon loading. The addition of the corresponding failure criterion allows prediction of the time to rupture by analysis of deformation diagrams. The model allows separation of the processes of viscous flow and of accumulation of damage in the material, and the fracture criterion allows rather precise prediction of long-term failure on the basis of much shorter experiments. The model can also be applied to other loading conditions, for example, fatigue. Figures 4; references 14: 12 Russian, 2 Western.
[39-6508]

USSR UDC 620.171.3:669.721+669.14+669.781

STUDY OF THE FRACTURE PROCESS IN MAGNESIUM-BASE COMPOSITE MATERIALS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 79 pp 16-17

MAKSIMOVICH, G. G., LYUTYY, YE. M., YELISEYEVA, O. I., KADYROV, V. KH. and GORDIYENKO, A. I., Physicomechanical Institute, Ukrainian Academy of Sciences, L'vov, and the Institute of Problems of Material Science, Academy of Sciences UKrSSR

[Abstract] Features of the fracture process were studied for magnesium-base composites of the ductile matrix-ductile fiber and ductile matrix-brittle fiber types at 20-400°C. MPF4 magnesium powder was reinforced with Kh13N13M2 steel fibers (ductile) 140 microns in diameter and boron fibers (brittle) 90 microns in diameter. The strength properties of the Mg-B composite were higher than the Mg-steel composite; at increased temperatures the tensile and yield strengths of both materials were diminished. Ductility of the Mg-steel composite was higher; starting at 200°, it improved with increased temperature, whereas ductility of the Mg-B material remained unchanged. Fractograms of the Mg-B material showed that the boron fibers were the source of failure of all test temperatures. Fracture of the magnesium matrix occurred via a ductile mechanism at all temperatures and at elevated temperatures compound crushing of the boron fibers in the fracture zone was observed. Also noted was an intensification of deformation at the fiber-matrix interface leading to crack development and subsequent failure. Figures 3; references 4: 2 Russian, 2 Western.
[55-6368]

USSR UDC: 666.539.219.3

STUDY OF PROCESSES OF MASS TRANSFER IN COMPOSITE MATERIALS WITH DIFFUSION BONDING

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov/Dec 79, pp 129-132, manuscript received 21 Apr 79

KRISHTAL, M. A., GONCHAROV, V. S., SHTEYN, L. M., Tol'yatti

[Abstract] A detailed study is presented of the diffusion bond in composites whose components are compatible in physical and chemical properties. The study was performed by creating a diffusion element in the iron-cobalt and iron-chromium systems. The method of x-ray microanalysis was used to study the kinetics of growth of the diffusion interlayer. The parameters of mutual diffusion served as the initial material for calculation of the kinetics of interaction between the parameters during the course of time. The experiments can serve as a basis for estimating the compatability of components of composites, the structure of the division boundary in composites and their physical-chemical properties. Figures 4; references 2: both Russian.
[64-6508]

USSR UDC: 621.791.3:669.018.9

PECULARITIES OF SOLDERING OF ALUMINUM-BASED COMPOSITES

Moscow SVAROCHNOYE PROIZVODSTVE in Russian No 8, Aug 79 pp 15-16

GRISHIN, V. L., Candidate of Technical Sciences, VOLCHKOV, A. N., ALDOSHIN, YE. V., Engineers

[Abstract] This work studies the specific features of the process of production of solder joints in aluminum-based composite materials. The studies were performed on plates of VKA-1 alloy 0.8-1.5 mm thick containing 43-50% boron fibers by volume, as well as this material plus OT4 titanium alloy 2.0 mm thick. The vacuum soldering methods were used with a composite solder consisting of a silumin eutectic and an aluminum alloy containing magnesium. Heat sources for local heating during soldering and solders with melting points of 450-500°C should be used to preserve the strength properties of the composite materials. Photographs are presented of the microstructure of the metal of solder joints of VKA-1 and VDA-1 plus OT4. Figures 1; references 4: 1 Russian, 3 Western.
[45-6508]

USSR UDC: 537.4:678.5.06

EXPERIMENTAL ESTIMATE OF STRENGTH ANISOTROPY IN UNIDIRECTIONAL REINFORCED ORGANIC PLASTIC

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 5, Sep/Oct 79 pp 799-803, manuscript received 13 Mar 79

SOKOLOV, YE. A., Institute of Polymer Mechanics, Academy of Sciences, Latvian SSR, Riga

[Abstract] An experimental study is performed of the strength of a unidirectional plastic based on organic fibers and an epoxy binder with a reinforcement factor of 0.64. The work was performed in the following sequence: the short-term strength of the material was determined with various types of stresses; the strength surface determined from the experiments was described for the case of a flat stress state; finally, the anisotropy of strength of the material in tension and compression was estimated. Cross sections of the strength surface of the material in three planes are presented. The data produced indicate that it is possible to describe the strength of the material studied by means of a second-order surface equation containing linear and quadratic terms. The results of the work can be used

to estimate the strength of multilayer organic plastics of this type if a unidirectional reinforcing layer is used as the primary structural element of the material. Figures 2; references 28: 26 Russian 2 Western
[39-6508]

USSR UDC 620.194

ENHANCING THE PASSIVABILITY AND ACID RESISTANCE OF TITANIUM AND STAINLESS STEELS BY MEANS OF THEIR ELECTROSPARK DIFFUSION PLATING WITH PALLADIUM

Moscow ZASHCHITA METALLOV in Russian Vol 15 No 6, 1979 pp 651-655 manuscript received 22 May 78

TOMASHOV, N. D., CHERNOVA, G. P., RESHETNIKOV, S. M., FEDOSEYEVA, T. A., VDOVIN, S. F. and KORNIYENKO, L. P., Institute of Physical Chemistry, Academy of Sciences USSR

[Abstract] Specimens of stainless steels and titanium were experimentally subjected to electrospark diffusion plating with a 5-um-thick layer of palladium. The specimens were tested for chemical behavior and corrosion resistance in solutions of aggressive acids (20-40% H_2SO_4 and HCl) at 20-100°C. Diffusion plating with palladium was found to shift the potentials of the steels and titanium into the passive region. Thus, for example, non-coated Kh25 steel in 20 and 40% H_2SO_4 displays a potential of the order of -0.34 to -0.35 volt, which corresponds to its active state and low corrosion resistance, whereas the steel coated with palladium displays potentials of 0.5 volt in 20% H_2SO_4 and 0.6 volt in 40% H_2SO_4, which correspond to a passive state and full corrosion resistance of the steel. In general, it can be concluded that cathodic electrospark deposition of such alloy elements as Pd, Ru, Pt and others on a thin surface layer (1-20 um) of stainless chromium and chromium-nickel steels, as well as of titanium and its alloys, can markedly enhance their passivability and corrosion resistance while at the same time reducing the expenditures of expensive alloy elements to 1 g/m^2. This method can also be used to increase the acid resistance of discrete surfaces on finished structural components fabricated from these alloys, e.g. the inside surfaces of containers, flanged joints, etc. Figures 4; references 17: 13 Russian, 4 Western.
[69-1386]

USSR UDC 621.357.7

STABILITY OF PASSIVE STATE OF TITANIUM IN HNO_3-CONTAINING CONCENTRATED HYDROCHLORIC ACID

Moscow ZASHCHITA METALLOV in Russian Vol 15 No 6, 1979 pp 684-686 manuscript received 24 Jul 78

KOPELNOVICH, D. KH. and IVLEV, V. I.

[Abstract] Nitric acid had been recommended as an inhibitor to protect titanium against corrosion in HCl. However, after some time of operation in concentrated (35 mass%) HCl treated with HNO_3 (40 g/liter), intensive corrosion of titanium had been observed. To investigate the cause of this accelerated corrosion, commercial titanium (VT1-0) was placed in concentrated HCl (25-35%) solutions containing from 0.5 to 40 g/liter HNO_3. The minimum necessary HNO_3 concentration assuring a stable passive state was determined as a function of the ability of titanium to get passivated after 5 min of cathodic polarization in the presence of a potential of -0.25 volt. For 35% HCl the minimum necessary concentration of HNO_3 was 18 g/liter, and for 30% HCl, 7 g/liter. However, prolonged exposure of HNO_3-passivated titanium in HCl solutions was found to result in a sharp displacement of the potential to the active region and acceleration of corrosion. Analysis of the solutions showed that the HNO_3 concentration decreases with increase in storage time, clearly owing to its reduction by HCl ($3HCl + HNO_3\ 2H_2O + NOCl + Cl_2$), thus resulting in the accelerated corrosion of titanium. Thus, either the time of contact between a given portion of the solution and titanium equipment should be limited or more nitric acid should be periodically added to the solution. Figures 1; references 3: all Russian. [69-1386]

USSR UDC 620.199

BEHAVIOR OF TITANIUM-PALLADIUM ALLOY IN CREVICE AND IN BULK SOLUTION OF CHLORIDES

Moscow ZASHCHITA METALLOV in Russian Vol 15 No 6, 1979 686-688 manuscript received 24 Jul 78

KURNOSIKOVA, V. N. and GORBACHEV, A. B., State Scientific

Research and Project-Design Institute of Basic Chemistry

[Abstract] The electrochemical behavior of "4200" Ti-Pd commercial alloy in crevice and bulk 5.3n NH_4Cl + 1.4 n. NaCl at 100-200°C was investigated, on conducting anodic polarization through every 0.1-0.2 volt from the corrosion potential. The alloy was found to display a high resistance to crevice corrosion and pitting corrosion in aerated and deaerated solutions.

Reducing the pH of the solution to 1 and subjecting the alloy to hydrogen absorption in crevice do not impede the passivation of the alloy. Laboratory corrosion tests corroborated the high resistance of the alloy under these conditions. During shop repair the alloy was used to build up the shaft-contacting flange surfaces of titanium equipment used in the production of ammonium chloride from the filter liquor of the soda shop. Prolonged operation of the facility with the thus coated flanges in the presence of the solution boiling at 135-140°C demonstrated the absence of crevice corrosion. Figures 1; references 6: 3 Russian, 3 Western.
[69-1386]

USSR UDC 620.194

PICKLING OF TITANIUM AND KH18N10T STEEL IN SULFATE SOLUTIONS

Moscow ZASHCHITA METALLOV in Russian Vol 15 No 6, 1979 pp 689-691 manuscript received 25 Nov 77

USOVA, V. V., KASATKINA, A. I. and PLOTNIKOVA, T. P.

[Abstract] When titanium is pickled in sulfate solution, HF or its salts are added, and when stainless steels are pickled, NaCl and $NaNO_3$ are added. When the pickling processes are combined, these ions can be simultaneously present. In this connection, the effect of these additives on the pickling of VT1-1 titanium and Kh18N10T stainless steel in 15% H_2SO_4 was investigated. It was found that in the fluoride-containing solution the potential of nonpolarizable titanium is -0.6 volt and that of steel, -0.16 volt. The dissolution rate of titanium is nearly two orders higher. Against this background, chlorine ions do not affect the polarization and dissolution rate of titanium. As regards the stainless steel, the most rapid removal of scale from steel is achieved in HF-containing solutions, but then treatment with $NaNO_3$ is also necessary, since as little as 2% $NaNO_3$ is instrumental in causing the potential of the steel to become somewhat more positive than zero. Fluorine-containing H_2SO_4 solutions used to pickle titanium can be re-used to pickle stainless steel upon being treated with $NaNO_3$. Figures 2; references 6: 5 Russian, 1 Western.
[69-1386]

USSR

UDC 620.193

CORROSION OF METALS IN THE ATLANTIC OCEAN

Moscow ZASHCHITA METALLOV in Russian Vol 15 No 6, 1979 pp 697-700 manuscript received 9 Nov 78

ULANOVSKIY, I. B., Institute of Oceanology, Academy of Sciences USSR

[Abstract] Corrosion tests of St3 carbon steel, Kh18N10T stainless steel, M1 cooper, L63 brass, and AMg-5M and AmtsM aluminum alloys were conducted for 20, 40, and 70 days in the Sargasso Sea by immersing the metal specimens at 16 different depth levels, from 2 to 5000 m and then measuring the weight loss during the periods of immersion. The corrosion of carbon steel was found to decrease with increasing depth, particularly below the 1000 m depth level owing to the lower temperatures and slower currents at these depths and also owing to the increased presence of biogenous elements (silicic acid, nitrites, nitrates, and phosphates) which slow down the corrosion of carbon steel. After 20 days the corrosion rate at the maximum depth decreased by 10-15% in the Atlantic Ocean, compared with a sevenfold decrease in the Pacific. As for copper, at 2-500 m depths its corrosion rate was 0.08 g/m^2.hr, whereas below these depths it was only one-third as high. As for brass, it underwent a fairly uniform surface dezincing and its corrosion rate over 20 days was 1.5 times as high. As in the case of copper, subsequent corrosion after 70 days was insignificant. As regards the aluminum alloys, their corrosion rate at lower depths was one-sixth to one-seventh as high as in the 2-500 m layer. As regards the stainless steel, it displayed insignificant corrosion at all depths in the Atlantic compared with its catastrophic corrosion in the Black Sea and moderate corrosion in the Pacific. References 12: 10 Russian, 2 Western.
[69-1386]

REASONS FOR UNSTABLE OPERATIONS AT THE DNEPROVSK ORE ENRICHMENT COMBINE

Moscow EKONOMICHESKAYA GAZETA in Russian no 52 Dec 79 p 9

[Article by V. Afonin, director of the Dneprovsk Ore Enrichment Combine, "The Reasons for Unstable Operation"]

[Text] Ore enrichment combines have become the main suppliers of iron-ore raw materials for metallurgical factories. Five such combines (GOKs) operate in the Krivorog basin. The discovery of beds of iron quartzites in Kremenchug rayon was a great success for prospecting geologists. But they require enrichment. The Dneprovskiy GOK has become the leader in exploitation of iron ore raw materials. It became one of the operating enterprises in 1970. Now the combine processes 27,000,000 tons of crude ore and produces more than 11,000,000 tons of concentrate and 5,000,000 tons of pellets.

We will strive to realize the designed outputs of the enterprise as quickly as possible. The average annual production increase in the current five-year plan exceeds fifteen percent.

Construction of the Dneprovskiy GOK is continuing. Expansion of the principal works, the mine and the enrichment plants, is nearing completion. The buildings of a second pelletizing plant are going up.

According to the design, the production outputs must grow, by the end of the current five-year plan, to 34,000,000 tons of crude ore, 14,000,000 tons of concentrate, and 12,000,000 tons of pellets per year. The numbers are impressive. However, a serious obstacle has arisen at the works. The new output goals are not being met at a satisfactory tempo. For several years now, a number of basic problems have not been solved.

One of these problems is the development of the open pit. They have fallen behind from the very first day of operations. According to plan, the first line should have yielded 21,000,000 cubic meters of raw ore per year. The combine did not achieve such a level even nine years after introduction of the first line. In actuality, during all the years of its operation, the strip mining operations are fulfilling only 65 to 68 percent of the planned volume.

What is the chief reason for this situation at the open pit works? The application of high-production ore transporting equipment was envisioned for working the strip mine and extracting the ore: 8-cubic excavators, 75-ton dump trucks, trunk line diesel locomotives with 3,000 horsepower rating and other technology. However, these forecasts are still unrealized.

Almost half of the hauling vehicles are four-cubic excavators, which are badly in need of repair. Twenty-seven ton and 40-ton dump trucks are used for transport of the ore material. Railroad transport is in a worse state of affairs. Two thousand horsepower diesel locomotives were sent to us after being used for a long time hauling steel. To top matters off, the USSR Ministry of Ferrous Metallurgy doesn't have an appropriate repair facility.

This is only one aspect of our troubles. The equipment we do have is not being utilized effectively. After a long delay the builders finally finished construction, in 1978, of the mine repair shops and the diesel car depot. One would think that, after these shops begin functioning, repairs and maintenance of mining, transport, railroad, and other equipment would improve.

However, the repair shop buildings are practically empty. Two-thirds of the machining, forging and pressing, depot, and garage equipment has not been issued by the planning organs and the USSR Ministry of Ferrous Metallurgy. The repair organizations of the ministry do not at all satisfy our requests for centralized repair.

The situation is worsening because of the stingy supplying of spare parts and materials. In the first half of 1979 alone the excavators stood idle waiting for repair for more than 37,000 machine hours, the vehicles waited 75,000 hours, and the diesels waited 22,000 machine hours.

Because of the unsatisfactory amount of strip mining work and the insufficient output of ore, the threat of "straightening out" the strip mine operation hangs over us. What is the way out of this mess? The way out is a sharp increase in the rate of strip mining and in the preparation of ore reserves. The USSR Minchermet is called on to improve the organization of centralized repair of the existing technology. At the combine we have to do much to improve production management and the use of equipment and also to strengthen labor discipline.

The pelletizing plant is not operating consistently. One of the reasons is the lack of designers. The leadership of the combine, together with the UkrSSR Minchermet, is paying greater attention to this plant. Inefficient equipment is being replaced, many sections are being rebuilt, and reserve parts are being manufactured. But the general designer, "Yuzhgiproruda" and the authors of the technology of enrichment, the institites "Mekhanobr" and of pelletizing, "Mekhanobrchermet," have taken an absolutely incomprehensible position. They practically abandoned their own offspring with many shortcomings.

Nevertheless, our leadership is full of optimism. An important part of the five-year plan is being accomplished. A modern town is going up on the shore of the Dnepr. We hope that the interested organizations and institutions, and above all, the workers of the appropriate departments of the Gosplan of the USSR, USSR Gossnab, and USSR Minchermet will help us to overcome our temporary difficulties.
[66-9424]

9424
CSO: 1842

USSR UDC 621.78:620.186:620.17:669.295.5

EFFECT OF HEAT TREATMENT ON THE PROPERTIES AND STRUCTURE OF VT9 ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 79 pp 55-57

SOLONINA, O. P., LYAPICHEVA, N. F. and BILIBINA, YE. N.

[Abstract] The mechanical properties and structural transformations taking place in VT9 alloy were studied in relation to heating temperature, cooling rate, and aging modes for blanks that were water quenched and air cooled. Soaking was done for one hour at 600-1200°C followed by aging at 100-750° for two hours and air cooling. After the above heat treatments were performed on VT9, metastable alpha'-, alpha"- and beta_M-phases were formed. In relationship to the quantitative ratios of these phases, their dispersity and precipitation shapes, it is possible to achieve a variety of properties. Maximum strength properties (TS = 140 kgf/mm^2, YS = 125 kgf/mm^2) with satisfactory ductility (E = 10%, RIA = 25%) can be achieved after water quenching from a one-hour soak at 950° and aging for two hours at 530° plus air cooling. Minimum strength properties (TS = 105 kgf/mm^2, YS = 75 kgf/mm^2) and maximum ductility is produced by soaking at 850-900° for one hour and water quenching. Maximum strengthening of VT9 alloy is produced as a result of decomposition of the martensitic alpha"-phase during aging. The formation of equilibrium alpha- and beta-phases as a result of aging the beta_M- and alpha'-phases produces less strengthening although the absolute values of strength are higher. Figures 3.
[55-6368]

NEW HORIZONTAL MULTI-PASS MACHINE FOR THE CONTINUOUS CASTING OF STEEL BLANKS

Moscow IZVESTIYA in Russian 12 Dec 79 p 1

[Article by A. Koptsov: "On the Horizons of Research"]

> A new horizontal multi-pass machine for continuous casting of steel blanks has begun operation at the scientific research association "Tulachermet."

Continuous casting allows one to automate the entire process from smelting of steel to rolling, to increase the yield of ready-to-use metal and its quality, and to improve working conditions. That is why the main thrust for growth of the national economy of the USSR for 1976-1980 includes a significant increase in the output of units for continuous casting of steel.

When I approached the unit I was not surprised by its size. Herein lay one of its principal advantages. The Tula innovation does not require high towers or deep pits for its assembly. This machine fits into an ordinary casting shop easily, rising only three meters above the floor. It was manufactured at the request of the Moscow association "AvtoZIL" and has already produced the first industrial lots of small-diameter steel blanks. This makes it possible for automobile manufacturers to produce parts by stamping without having to roll the blanks.

V. Simonov, the head of the "TulaNIIchermet" institute laboratory, says: "This new technique will increase productivity by 26 to 33 percent. On the whole, the economic effect of the horizontal casting machine will result in an annual savings of 2,000,000 rubles.

The machine was developed by a team of the scientific-industrial association "Tulachermet" in cooperation with specialists of the Ukrainian Scientific Research Institute of Metals. It far surpasses all modern units. The horizontal method of casting makes it possible to produce blanks of varying gage and to increase their quality. After rolling round blanks for seamless tubes with a diameter of 130 millimeters at the Rustabskiy Metallurgical and Pervoural'skiy New Tube factories the output of satisfactory metal increased by up to 99 percent. The entire rolled output of reinforced sections produced at the Karagandinskiy and Liyepayskiy metallurgical factories met the GOST standards.

The "Horizontal Unit" has a lot of other advantages over modern units. Its assembled weight is $\frac{1}{1.6}$ -- $\frac{1}{1.8}$ less than for a radial unit, and even less than this for a vertical unit. The low height and compactness allow one to install horizontal machines in shops which are currently operational. The simplicity of design and clever placement of units facilitate operation and repair.

Many metallurgical factories have proceeded with construction of such machines. Foreign firms are also interested in them. From all the evidence it is obvious that the prospects for the horizontal machine for continuous casting of steel blanks are very good.
[65-9424]

9424
CSO: 1842

USSR UDC: 669.715-153

EXPERIENCE IN THE OPERATION OF A FURNACE WITH AN AIR CUSHION FOR CONTINUOUS ANNEALING OF STRIPS OF ALUMINUM ALLOYS

Moscow TSVETNYYE METALLY in Russian No 10, Oct 79 pp 86-89

TSUKROV, S. L., PASKHIN, L. N., SHCHELBANIN, YU. V., SVETLOV, V. T.

[Abstract] A study is made of the experience of three years' industrial operation of a continuous aluminum strip annealing furnace in which the strips are transported on a cushion of air. The furnace was designed for heat treatment of strips 800-1500 mm wide and 0.8-2.0 mm thick made of non-hardened aluminum alloys. Strip transport conditions and uniformity and intensity of heating and cooling were measured over the course of two years. The operating modes assuring defect-free transportation of the strip on the air cushion were found to be determined by the air pressure in the upper and lower supporting chambers, as well as the tension on the strip in the furnace. Optimal conditions include suspension of the strip 50-70 mm above the nozzle apparatus, with vertical oscillations of the position of the strip not over 20-30 mm. The mean values of heat transfer coefficients are determined by the various sections of the furnace.
[40-6508]

USSR UDC 669.721.5:620.184

EFFECT OF ZIRCONIUM ON THE STRUCTURE AND MECHANICAL PROPERTIES OF MAGNESIUM-BASE HETEROGENEOUS ALLOYS

Moscow IAN SSR, METALLY in Russian No 6, 1979 pp 149-153 manuscript received 3 Jun 77

CHUKHROV, M. V. and KHRISANOVA, Z. I., Moscow

[Abstract] The effect of zirconium on the structure and mechanical properties of the heterogeneous magnesium-base alloys Mg + 4.0% Zn + 1.0% Cd + 1.5% Nd, Mg + 4.0% Y + 4.0% Zn + 0.5% Cd + 1.5% Nd, Mg + 5.0% Y + 4.0% Zn + 1.0% Cd + 1.5% Nd, and Mg + 9.0% Y + 6.0% Zn + 1.0% C + 2.5% Nd was investigated. These alloy compositions were selected with allowance for the attention currently being devoted by researchers to the development of new high-strength alloys based on the Mg + Y system. They were treated with 0.16-0.7% Zr. Treatment with Zr resulted in the suppression of dendritic form of the crystals and the appearance of equiaxial crystals in these alloys. Interacting with the acicular zinc-rich phase of the eutectic, the zirconium alters its form and contributes to a more uniform and compact distribution of that phase among the grains of the solid solution. In addition, zirconium contributes to a more uniform distribution of zinc in the grains of the solid solution. As a result, zirconium, when introduced in amounts of from 0.5 to 0.66%, can enhance the mechanical properties of heterogeneous Mg-base alloys, though it does not enhance the mechanical properties of high alloys of the Mg-Y-Zn-Nd-Cd system (at combined treatment with yttrium and neodymium the solubility of neodymium in magnesium decreases by 35% and the solubility of yttrium, by 14%). Figures 2; references 6: 4 Russian, 2 Western. [70-1386]

USSR UDC: 669-494:669.7785'5'721

MECHANICAL PROPERTIES OF PLASMA-DEPOSITED ALUMINUM ALLOY IN THE SYSTEM Al-Zn-Mg, USED AS A MATRIX FOR A FIBROUS MATERIAL

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov/Dec 79, pp 116-120, manuscript received 21 Apr 79

ALIPOVA, A. A., IVANOV, V. V., IVANOV, V. G., KUCHKIN, V. V., KHVOSTUNKOV, A. A., Leningrad

[Abstract] A study was made of the mechanical properties and structure of a plasma-deposited material of high-strength thermally hardened Al-Zn-Mg alloy under various modes of gas-static pressing and heat treatment. The influence of the parameters of gas-static pressing on the structure and mechanical properties of the deposited alloy was studied. The strength of the pressed material increased primarily with an increase in temperature and time of pressing, while the relative elongation and Young's modulus remained virtually unchanged. The pressing conditions optimal for the fiber material did not provide maximum strength of the matrix. Matrix strength can be increased by 40% by heat treatment. The combination of vacuum annealing and standard heat treatment can significantly increase the strength and particularly the ductility of the pressed matrix. Figures 2; references 3: 2 Russian, 1 Western.
[64-6508]

UDC 061.6;622.343.5.012.001.2.001.5

ACTIVITIES OF THE MINING ENGINEERS OF THE UNIPROMED' INSTITUTE

Moscow GORNYY ZHURNAL in Russian no 12, Dec 1979 pp 11-14

[Article by V. B. D'yakovskiy, deputy director for mining scientific research operations, V. Ye. Popov, deputy chief engineer, and V. Ya. Firsov, senior engineer]

[Text] Unipromed' is a complex scientific-research and design institute, which conducts projects in the area of mining science, enrichment and metallurgy for the copper, zinc and gold-platinum industries.

The volume operations carried out by the institute is more than 2,500,000 rubles for the scientific section, and 2,100,000 rubles for the design section, which includes 1,000,000 and 1,300,000 rubles respectively for mining subject matter. In the tenth five-year plan alone the mining laboratories have achieved a savings of 70,000,000 rubles by the adoption of their schemes in production and a savings of 40,000,000 rubles by adoption as projects. The institute furnishes 50-60,000,000 rubles' worth of designs annually to mining enterprises.

Since 1976 Unipromed' has been fulfilling the functions of a coordinating organization and it is the main institute for the following problems: controlling underground fires, development of technology for underground extraction with walling up of the worked areas, effective and safe operations in quarries, stability of quarry edges, control of underground detonations and rock pressure, ventilation of deep open pits, bacterial leaching of ferrous and rare metals of their accompanying ores.

The institute, in cooperation with mining enterprises, has developed and introduced new technology, which mades it possible not only to eliminate underground fires, but also to prevent them. For the elimination and prevention of endogenic fires they fill up the worked sections with a clay mud on a scale unknown in the world up to now. On the basis of results of studies done over many years and of experience in controlling fires, the scientists of the institute have developed a methodology for determining the degree of fire hazard of newly proved deposits under laboratory conditions, which permits one to specify the necessary measures for safe working of deposits at the design stage. The technology for prevention of underground fires which the institute has developed permits the use of highly productive systems (block-induced caving and sublevel caving with increased height of a level). This technology is widely used in many Soviet and foreign mines.

Of great importance are the institute's studies in the area of improving chamber systems using a hardening fill which makes it possible to increase the extraction of ore from the depths, to eliminate the danger of fire, and to significantly increase the yield of minerals. Thus, the Gayskiy Mining and Enrichment Combine has introduced a basically new system of working with continuous extraction of ore and with filling of the worked space by hardening mixtures, which make it possible to work a deposit by the open and underground methods simultaneously (see drawing), to increase the extraction of ore several-fold and to obtain significant savings.

Two directions in working deposits by the underground method should be noted: the improvement of systems which are traditional for copper pyrite deposits of the Urals with caving and preventive filling; the creation and introduction of new versions of systems with hardening fill and the use of self-propelled equipment.

Systems with caving and preventive filling are mainly used in active pits during the opening of lower horizons, and also during working of separate sections in new pits.

In order to improve these systems researchers of the institute solve problems of the rational location of shafts, of the decrease in the yield of off gage ore during its withdrawal, work up designs for connecting the withdrawal ramps, determine the area of application of vibration machines, self-propelled equipment and loading and transport vehicles of Soviet and foreign manufacture, create metallic, portable timbering, which is used beneath a collapse of blasted ore, making it possible to eliminate penetration of withdrawal ramps.

Systems with hardening fill and self-propelled equipment are used in designing new pits. The table gives the relative frequency (%) of engineering systems which are used in working deep horizons of the Gayskiy and Uzel'ginskiy deposits.

Systems of working	Deposit	
	Gayskoye	Uzel'ginskoye
Level-chamber with hardening timbering of chambers [breasts]	48.7	60.0
The same, with filling of secondary chambers by tailings or rock	28.3	17.0

In horizontal layers with hardening filling	8.6	23.0
Sublevel caving with filling in.	14.4	----

Investigations of the use of various production waste products (slags, nepheline and bauxite sludges, tailings of enrichment plants, heat and power station ash, waste rock, etc.) are being conducted in an attempt to lower the cost of fill. The regenerated technical level of preparation and transport of fill mixtures and the elevation of the filled-in mass significantly improved the technical and economic characteristics of systems with filling and the ore quality; losses and exhaustion were reduced respectively to 6.7 and 13.7 percent, the figures for the Gayskiy mine being 4.9 and 10.7 percent.

Experience has shown that a decrease of losses and exhaustion compensates for expenditures for production of filling operations. The use of systems with filling and self-propelled technology significantly increases labor efficiency at underground mining operations. The plan for stripping and preparing a site and the sequence of working it are altered by the use of hardening fill. Also, selection of more efficient measures to protect structures and preservation of the surface from the harmful influence of mining operations are possible. Thus, for example, ores are worked in a protected block of a mine shaft at the Krasnogvardeyskiy mine pit; at the Gayskiy mine pit mineral extraction is conducted on two or three levels simultaneously; at the Uzel'ginskiy pit priority is given to extraction of ores of the lower levels.

Investigations of scientists, as well as Soviet and foreign experience in working ore beds at great depths, indicate that the harmful effect of increased rock pressure is decreased during single-stage continuous removal of ore with filling and by creating a front of operations from the worked space to the mass of ore with a minimal amount of forward drifts and without abandoning any blocks. Such systems are being used in projects of modern Ural copper mines, which work deposits at great depths.

Plans of the Gayskiy, Uzel'ginskiy, and Podol'skiy mines call for tunneling from the surface of access ramps, which permit one to rapidly and with minimal effort lower to a mine and pull up to the surface the self-propelled vehicles, equipment, explosives, fuel and lubricating materials. This also permits increased management efficiency of mining operations.

The institute's scientists have made a significant contribution to the development and soundness of methods for controlling rock pressure and shifting of rocks at enterprises of the copper and aluminum industries of the Urals. A methodology of comprehensive observations of the shifting of rocks (observation points in rock drifts, in deep wells and on the surface) was first developed in the USSR by the institute. Instrumental observations and modeling on equivalent materials permitted establishment of the general principles of the formation of shifting of a large rock mass.

Rules and instructions for protecting structures and natural resources from the harmful effects of underground mining operations during working of copper and bauxite deposits have been developed on the basis of these investigations. The experience in controlling rock pressure gathered at the Ural mines is used at many mining enterprises of the USSR Ministry of Ferrous Metallurgy.

The open method of ore extraction has played an important role in the growth of mining production. It permits the use of powerful mining equipment, SBSh-250 and BASh-250 cutting boring machines, EKG type earth movers with four-, six- and eight-cubic-meter shovels, 27-, 40- and 60-ton automatic dump trucks, and tracked loaders. The percent of ore extraction done by the open method has continuously increased, reaching more than 70 percent in 1978.

Researchers of the institute have developed scientific bases for the design of quarries, which include a stage-wise working of deposits, the construction of inclined benches, the use of special equipment for working marginal strips and inclined wells, and for sloped skip hoisting of the rock. This allows significantly reduced initial capital outlays, accelerated exploitation of quarries, reduced number of strip pits, and increased productivity of miners. Thus, the depth of the Sibayskiy quarry at the first stage of working was 260 m, and 400 m at the second; at the Uchalinskiy quarry these depths were 240 m and 310 m respectively.

Creation of inclined benches at the Sibayskiy quarry yielded a saving of up to 400,000 rubles annually due to a decrease in the amount of stripping. The first Soviet skip hoist for removing rock to the surface was constructed and put into operation at this quarry. As a result, transport expenditures were reduced by 500,000 rubles a year.

Mining engineers of Unipromed' have carried out a set of investigations of seismically stable technology of drilling and blasting operations, for establishing the relation of the quality of crusing rock by blasting to their physico-mechanical and structural properties, power indices, and the technology of detonating charges of explosives during the production of large blasts with a power up to 1,500 tons of explosives. Using the results of these investigations in production has allowed an increase in the scale of blasting operations by a factor of 2 to 3, a reduction in the yield of off size rock by a factor of 1/2 to 1/5, an increase of 15-20 percent in mining transport equipment and a yearly savings on the order of more than 2,000,000 rubles.

The institute has also developed a technology for drilling and blasting operations with charging of wells after drilling on the basis of modern, improved blasting materials. Commercial tests of the proposed method which have been conducted on a large scale (Uchalinskiy ore enrichment combine, the mining and metallurgy combine Pechenganikel') indicate that its adoption by industry produces a saving of up to 5 to 6,000,000 rubles a year.

The institute's scientists were the first in the USSR to carry out tests to determine the causes of spontaneous detonations of explosives in aggressive media, and they developed a set of effective organizational and technical measures to prevent them.

In order to protect the surrounding environment and to improve the sanitary and health conditions of miners in quarries, technology for ventilating quarries by powerful, universal, reactive units, methods for strengthening and dust removal of quarries and access roads, and methods of controlling dust during reloading of rock ore on a skip hoist were developed for the first time in ferrous metallurgy and put into practice.

In the next 10 to 15 years the relative amoung of underground extraction of ore will increase significantly in the Urals, chiefly due to working of deposits at great depths at existing and new pits.

In this connection most of the attention of mining engineers will be directed to:

the improvement of and search for new versions of systems of exploitation with filling of the worked area and the use of sets of highly efficient self-propelled vehicles;

the search for optimal compositions of hardening fill for specific conditions and for methods of transporting it great distances;

assuring maximal concentration of mining operations, the introduction of continuous-line systems of breaking up ore, raising and transporting it, and increasing the intensity of breaking extraction;

increasing the haulage distance of ore by self-propelled vehicles and a significant reduction in the number of transport drifts;

improvement in prevention of endogenic fires, search of methods of controlling dust and gas contamination, introduction of non-dusting roofs of roadways in quarries and in underground drifts;

extensive dissemination of access ramps and self-propelled equipment at main and auxiliary workings;

development and introduction of automated sytems of controlling (ASUPTP) mining operations, mechanization of auxiliary operations;

development and introduction of methods and technical means of investigations during a study of the problems of shifting of rocks, rock pressure and rock shocks, stability of quarry walls, protection of resources and reseeding of the ground.

For the successful solution of these problems one must significantly increase the output of self-propelled equipment for all kinds of mining operations, improve the quality of vehicles, provide automatic control of machines and computers on drilling cutters, which assure their operating according to an assigned program.

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[68-9424]

9424
CSO: 1842

USSR UDC 681.846.73

USE OF FLAME-SPRAYED COATINGS IN THE TAPE DRIVES OF VIDEO TAPE RECORDING EQUIPMENT

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, 1979 pp 57 manuscript received 11 Aug 78

KALYUZHNYY, A. D., SHUL'GA, O. V., KARPINOS, D. M. and ZIL'BERBERG, V. G., Institute of Problems of Material Science, Academy of Sciences UKrSSR

[Abstract] The tape drive of videotape recorders must be particularly wear resistant, since it is in friction contact with tape. In this connection, the authors developed the compositions and techniques of application of flame-sparyed coatings to tape-drive spools. Of the compositions tested (chromium, copper, chromium+copper, and bronze), chromium+copper (50+50) proved to be the best. Coatings 0.1-0.3 mm thick were flame-sparyed onto tape-drive components, and it was found that the resulting coefficient of friction between flame-sprayed surfaces was lower (0.28) than in the case of tape drives coated with the normally used Kh18N9T steel. Moreover, jamming of tape is completely precluded, so that the use of flame-sprayed coatings in the tape drives of videotape recorders represents a promising technique. References 5: all Russian

[77-1386]

USSR UDC 669.1'295'781'784.017.1

THE QUASI-TERNARY SYSTEM Fe-TiC-TiB_2

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, 1979 pp 60-64 manuscript received 9 Jan 78

SHURIN, A. K. and RAZUMOVA, N. A., Institute of Metal Physics, Academy of Sciences UKrSSR

[Abstract] Alloys of the quaternary system Fe-C-B-Ti were investigated within the concentration range bounded by the Fe, TiC, and TiB_2 phase compositions. Since systems Fe-TiC, Fe-TiB_2, and TiC-TiB_2 are quasi-binary and belong in the eutectic type, it can be assumed that the system Fe-TiC-TiB_2 is quasi-ternary, with a ternary eutectic. It is shown that this quasi-ternary system forms a simple fusibility curve with a ternary eutectic fusing at 1170°C. The structure of the eutectics in the investigated alloys is characterized by the formation of a metal matrix. The hardness of castings of these alloys increases markedly with increase in their concentration of TiC or TiB_2. The hardness of the TiC-TiB_2 eutectic is minimal compared with the noneutectic alloys of that quasi-binary system. Figures 3; references 3: all Russian.

[77-1386]

USSR UDC 620.18.186.667.764

EFFECT OF STRUCTURAL CHANGES ON CREEP PARAMETERS OF BINARY CARBIDE COMPOSITIONS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, 1979 pp 82-88 manuscript received 10 Jan 79

ANDRIYEVSKIY, R. A., SPIVAK, I. I., MITROKHIN, V. A. and KLIMENKO, V. V., Moscow Institute of Fine Chemical Technology

[Abstract] In view of the known existence of high creep (superplasticity) in certain two-phase compositions, the conditions of decomposition within the TiC-ZrC system were investigated for compaction molded specimens annealed at 1850, 1900, and 1950°C for up to 100 hr, as well as for specimens tested for creep during bending and dilatational straining. It is established that the strain rate of the original two-phase TiC-40% ZrC alloy is roughly 1.5 orders of magnitude greater compared with the homogeneous solid solution. It is shown that inhomogeneous alloys in the TiC-VC system display a higher creep rate than do homogeneous alloys. The similarity between activation energies in creep experiments and in experiments with the auto-diffusion of Zr, Ti metal atoms in ZrC, TiC carbides qualitatively points to a diffusion mechanism of creep of the TiC-40% Zr alloy. Figures 4; references 21: 17 Russian, 4 Western.
[77-1386]

USSR UDC 621.315.61

REACTION-TYPE SINTERING OF BORON NITRIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, 1979 pp 52-56 manuscript received 16 Apr 79

RUSANOVA, L. N., GORCHAKOVA, L. I. and ROMASHIN, A. G., Obninsk

[Abstract] Reaction-type sintering (RTS) is a method of activated sintering and it is best applied in cases in which the sintered material lacks diffusion mobility. This is true of compounds with chiefly covalent bonding, of which boron nitride is a typical representative. In this connection, the RTS of a material consisting of turbostratic-structure boron nitride powders and amorphous boron in a nitrogen atmosphere is described. During RTS the compaction of the material is accomplished through the formation of a new boron nitride phase resulting from the chemical reaction between amorphous boron and nitrogen. A formula for the attendant changes in mass and volume

during such nitriding is presented. It is experimentally established that powders with a high oxygen content are the most promising material for RTS, since oxygen and the processes associated with oxidation during RTS are decisive to obtaining high-strength specimens. The mechanism of the RTS of boron nitride is determined by two main reactions: the nitriding of boron and the oxygenation of boron by the oxygen released from the lattice of turbostratic nitride. Figures 4; references 8: 7 Russian, 1 Western.
[77-1386]

USSR UDC 621.724

EFFECT OF POWDER DISPERSITY ON THE SINTERING OF ZIRCONIUM NITRIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, 1979 pp 33-39 manuscript received 30 May-79

PSHENICHNAYA, O. V., KUZENKOVA, M. A. and KISLYY, P. S., Institute of Problems of Material Science, Academy of Sciences UkrSSR; Institute of Superhard Materials, Academy of Sciences UkrSSR.

[Abstract] The smaller the particle size the more active the process of the sintering of powder becomes. However, relatively few studies have been made of the dependence between the dispersity of the powder and the possible mechanisms of sintering. To fill this gap, the effect of dispersity on the sintering kinetics and grain recrystallization was investigated in billets compacted from classified monodisperse powders of zirconium nitride (fractions <3; 5-7; 14-20; and 40-60 um). Powders of each fraction were compacted into cylindrical specimens measuring 8 mm in diameter and 16 mm in length. The specimens were then vacuum-sintered and curves of their sintering kinetics were plotted. The shrinkage of specimens of the <3 um fraction reached 98% within the first 5 min and their porosity decreased to 3-5%; in comparison the figures for the larger fractions were much worse and the specimens of the largest fractions (20-20 and 40-60 um) underwent virtually no sintering at 1800-2000°C and their porosity was almost unchanged. The size of recrystallized grains in the sintered ZrN specimens was larger for specimens of the finely dispersed fraction (<3 um). This is apparently due to the coalescence of the fine particles owing to their sliding and rotation relative to each other upon the disappearance of their boundaries during sintering. Figures 5; references 9: 6 Russian, 3 Western.
[77-1386]

USSR UDC 621.762

HOT PRESSING AND VACUUM SINTERING OF HIGHLY DISPERSED TITANIUM NITRIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, 1979 pp 27-32 manuscript received 13 Feb 79

TORBOV, V. I., TROITSKIY, V. N., and RAKHMATULLINA, A. Z., Institute of New Chemical Problems, Academy of Sciences USSR

[Abstract] The sinterability of highly dispersed TiN (particle size 0.5 um) was investigated for billets obtained by hot pressing and vacuum sintering TiN powders. With increase in the unit surface area (dispersity) of TiN to 90 from 18 m^2/g the onset temperature of recrystallization of freely poured powder was found to decrease to 600 from 1300°K. The temperature of onset of virtually 100% density billets of hot-pressed TiN (particle size of the powder 0.05-00.7 um) was 1600°K, which is 500-700°K lower than the temperatures required for complete sintering of coarse-grained powders (particle size about 0.5 um). At hot pressing temperatures exceeding 1800°K the density of the sintered briquets began to decrease, apparently owing to the onset of release of nitrogen by the nitride and the formation of microcracks. The grain size of both hot-pressed and sintered specimens is roughly the same, and for sintered specimens it chiefly depends on the temperature and duration of the sintering. Figures 4; references 14: 13 Russian, 1 Western.
[77-1386]

USSR UDC 621.762.2

INVESTIGATION OF THE STRUCTURE OF THE SURFACE AND INTERIOR FORMATION OF TITANIUM ALLOY GRANULES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, 1979 pp 1-7 manuscript received 31 May 78

LOKSHIN, YE. deceased, L., BOCHVAR, G. A., BORZETSOVSKAYA, K. M., KAPUTKIN, YE. YA. and BOLOTINA, T. I., Moscow

[Abstract] The structure of the surface and internal layers of Ti alloy granules and its effect on the formation of poreless material was investigated on specimens of one of the most common Ti alloys, VT3-1. A special feature of these granules, ranging in size from 50 to 900 um, is the transition from dendritic to acicular structure and the appearance of the oc" phase with decrease in granule size. The state of the surface of the granules is characterized by the presence of 100-2000 Å thick films of

lower titanium oxides: Ti_2O_3, Ti_2O_5, Ti_4O_7. The thickness of these films increases with annealing temperature. High-temperature vacuum annealing at 900°C causes these films to dissolve. A qualitative consolidation of the granules with film thickness ~350 Å is observed at temperatures of 900°C and higher. The presence of 350 Å thick oxide film on the granule surfaces adversely affects the quality of the compact blanks pressed from the granules. Cyclic heating in the transition temperature range can enhance the plasticity of such blanks. Figures 3; references 4: all Russian. [77-1386]

USSR UDC: 669-494:536.4

THERMAL STABILITY OF THIN FILMS ON REINFORCED FIBERS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov/Dec 79, pp 125-128, manuscript received 21 Apr 79

GOL'DINER, M. G., MAZUR, V. A., Kishinev

[Abstract] Earlier experiments have indicated that there is a precise value of interphase energy above which the polycrystalline precipitate breaks down, while below which it is converted to an epitaxial film around the reinforcing fibers in composites. Other experiments have indicated that the thin film surrounding a fiber differs from a plane film in that uncompensated edge dislocations are located along the axis of the film, decreasing the morphologic stability of single crystal films of this type. These propositions were experimentally tested using nickel and aluminum films applied to carbon fibers about 6 um in diameter and plates of vitreous carbon, as well as copper plates applied to polycrystalline molybdenum and tungsten wire 50 um in diameter, polycrystals and various single crystals of molybdenum and tungsten. It was affirmed that the influence of substrate geometry on film breakdown is a threshold effect appearing when the elastic energy reaches a value on the order of the interphase energy. The behavior of a polycrystalline film during annealing is thus determined by two competing processes: breakdown of the continuous film and formation of the epitaxial film. Figures 2; references 4: all Russian.
[64-6508]

USSR UDC 620.186:620.17:669.295'71'28'292'1'3'296'6

INVESTIGATION OF THE STRUCTURE AND PROPERTIES OF A TITANIUM ALLOY IN THE Ti-Al-Mo-V-Fe-Cu-Zr-Sn SYSTEM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 79 pp 59-61

MOISEYEV, V. N., DOLZHANSKIY, YU. M., ZAKHAROV, YU. N. and ZNAMENSKAYA, YE. V.

[Abstract] VT14 titanium alloy was additionally alloyed with Sn, Zr, Cu and Fe. Mechanical tests were performed on samples of this alloy where it was found that strength increases with increased content of Sn, Zr, Cu, and Fe within the limits specified. The most effective strengtheners were Sn and Cu. After heat treating at 850°C for two hours followed by air cooling plus heating to 550° for six hours and air cooling the tensile strength of semifinished products, produced by deformation in the beta-region, amounts to more than 120 kgf/mm^2 with satisfactory ductility and operational reliability. This alloy is best suited to be used at 400-500°C. Figures 4.
[55-6368]

USSR UDC 669.27:620.17:669.295'71'296

EFFECT OF TUNGSTEN ON THE MECHANICAL PROPERTIES OF A Ti-9% Al-3% Zr ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 79 pp 58-59

NARTOVA, T. T., GRIGOR'YEV, I. P., STEPANOV, YU. N., and TARASOVA, O. B., Institute of Metallurgy imeni A. A. BAYKOV and the Chubashkiy Pedagogical Institute imeni I. YA. Yakovlev

[Abstract] Samples of a Ti-9% Al-3% Zr alloy were additionally alloyed with 0-10% W and tested in the forged (non-heat treated state) and heat treated state. Heat treatment consisted of a one-hour anneal at 900°C followed by a vacuum step anneal of 900° for 20 hours + 800° for 100 hours + 600°C for 100 hours and air cooling. Samples that were not heat treated as well as those that were underwent brittle fracture during tensile tests at 20°. At 600° the alloy samples possessed satisfactory ductility which was lost if the tungsten content was greater than roughly one percent. A tungsten content was greater than roughly one percent. A tungsten content of about 0.7% was found to be optimum providing small maximums of hardness and strength as long as the operating temperature was around 600°. Figures 1; references 5: all Russian.
[55-6368]

USSR UDC: 621.791.357:669.295

CONTACT-REACTIVE SOLDERING OF TITANIUM ALLOYS THROUGH AN INTERMEDIATE LAYER OF PALLADIUM

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 79, pp 17-18

BESEDNYY, V. A., (deceased) KANDYBA, YE. F., Engineers, All-Union Scientific Research Institute of Compressor Machine Building

[Abstract] A study is presented of the properties of joints in titanium alloys produced by contact-reactive soldering through an intermediate layer of palladium. Studies were performed on specimens of VT6S, VT14, VT3-1, VT5-1 and AT6 alloys. Plates measuring 12 X 12 X 100 mm were used to assemble specimens for metallographic studies. The active metal used was a palladium foil 99.9% pure. Soldering was performed in a vacuum furnace at 1160°C at a pressure of $1 \cdot 10^{-4}$ mm Hg followed by diffusion annealing at 960°C for 8 hours. The process improved the mechanical properties of the solder joints. Photographs illustrate the microstructure of the metal of the joints after soldering and after annealing. Figures 2; references 6: all Russian.
[46-6508]

USSR UDC 620.17:620.18:669.295.5

POSSIBILITIES OF INCREASING THE MECHANICAL PROPERTIES OF TITANIUM ALLOYS BY STRUCTURE OPTIMIZATION

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 79 pp 51-55

BRUN, M. YA., All-Union Institute of Light Alloys

[Abstract] Titanium alloys with a globular structure possess a certain set of mechanical properties while those with a lamellar structure possess a different set of properties almost completely opposite. By specific heat treatments it is possible to produce a mixed globular-lamellar structure which will possess the best set of properties from each of the structures. The mixed structure can be produced by heat treating at a temperature 15-30° below the polymorphic transformation temperature. Proper heat treatment of coarse grain alloys can produce a more optimum structure, depending on the mechanical properties being sought. Figures 5; references 3: all Russian.
[55-6368]

USSR UDC 620.193.4

THE EFFECT OF PURITY AND PRESSURE OF HYDROGEN ON THE GAS SATURATION OF TITANIUM ALLOYS

L'vov FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 15, No 6, Nov-Dec 79 pp 111-113 manuscript received 4 Jan 77

SUKHOTIN, A.M., ANTONOVSKAYA, E.I., SGIBNEV, YE.V. and SHUL'MAN, A.K., State Institute of Applied Chemistry, Leningrad

[Abstract] An experimental study was made to determine the dependence of the hydrogen saturation in VT1, OT4 and AT2 titanium alloys on the oxygen concentration and the pressure as well as on the length of treatment. Annealed specimens of these alloys were saturated first with pure hydrogen under a pressure of 10^3 Pa and then, while oxygen was added in amounts ranging from 10^{-6} to $1.6 \cdot 10^{-2}$ (commercial) vol.%, the rate of hydrogenation was measured at various pressures and temperatures over a period of 48 hours. Under 10^5 Pa at 500°C, typically, the mass concentration of saturating hydrogen was found to drop very fast with increasing volume concentration of oxygen. The isotherms indicate that the hydrogenation rate is highest in the case of pure gas and decreases with increasing oxygen concentration. Correspondingly, the temperature at which cracking will occur after a certain period of time becomes lower with increasing oxygen concentration. The temperature of catastrophic fracture on the other hand, while depending on the length of treatment, becomes higher with increasing oxygen concentration. This trend is attributable to "self-curing" by a protective oxide film. The isobars for almost pure hydrogen indicate that only the maximum hydrogen saturation level increases with increasing pressure, inasmuch as the alloying elements here do not form hydrides. Figures 4; references 5: all Russian.
[61-2415]

USSR UDC 669.295.5:539.43:620.194.8

FEATURES OF FATIGUE FRACTURE OF TITANIUM AND ITS ALLOYS IN AN NaCl SOLUTION

L'vov FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 15, No 6, Nov-Dec 79 pp 86-88 manuscript received 28 Feb 77

POKHMURSKIY, V.I., YAREMCHENKO, N. YA., KALAKHAN, O.S. and PRISHLYAK, A.M., Physico-Mechanical Institute, Academy of Sciences UkrSSR, L'vov

[Abstract] A metallographic and fractographic study was made to determine the effect of a corrosive medium such as an aqueous NaCl solution on the fatigue fracture of various titanium alloys. Metallographic specimens of VT1 (α), VT5 (α), AT3 (α'), PT3V (α') and VT14 ($\alpha+B$) alloys were tested under stresses of $(1.05-1.10)\sigma_{-}$ and $1.30\sigma_{-}$. While fracture in 3% NaCl was found to be more brittle than in air, to an extent depending on the alloy composition, this corrosive medium was found to lower the endurance limit of the $\alpha+B$ alloy, to raise the endurance limit of the α' alloys, and in the case of the α alloys to either lower or raise it. Figures 2; references 7: 6 Russian, 1 Western.
[61-2415]

USSR UDC: 669.295

CONCERNING THE INFLUENCE OF RELATIVE HUMIDITY OF THE AIR ON THE QUALITY OF SPONGE TITANIUM

Moscow TSVETNYYE METALLY in Russian No 10, Oct 79 pp. 56-57

CHEREPANOVA, YE. A., NIKITINA, T. I., GULYAKIN, A. I., YATSENKO. A. P.

[Abstract] A study was made of the variation in quality of sponge titanium as a function of the relative humidity of the air in which the titanium sponge is treated. This was achieved by analysis of statistical data from a titanium-magnesium enterprise covering the period 1973-1977. Weighted-mean quality indices were calculated, temperature and relative humidity of the air in the titanium sponge processing areas were systematically measured, and information from the city weather station was also used. Correlation analysis showed that the hardness and oxygen content of the titanium sponge depends significantly on the absolute moisture content of the atmosphere, as well as the difference in the temperatures between the air outside and the air temperature within the titanium sponge processing room. This is particularly clearly seen in summer. No variation was found in content of chlorine, nitrogen or iron in the titanium sponge as a function of the factors measured. Figure 1; references 11: all Russian.
[40-6508]

USSR UDC 669.295

MOISTURE ABSORPTION BY TITANIUM SPONGE DURING ITS REPROCESSING INTO A COMMERCIAL PRODUCT

Moscow TSVETNYYE METALLY in Russian No 11, Nov 79 pp 74-76

ALEKSANDROVSKIY, S.V., CHEREPANOVA, YE.A., VOROTINOVA, B.G., POPOVA, S.V. and GULYAKIN, A.I.

[Abstract] For a more accurate control of titanium sponge reprocessing, its interaction with moisture during drying, casting and subsequent operations as well as during storage in air was evaluated with the stable isotopic tracer ^{18}O (heavy oxygen) in water. Bloom and furnace specimens were tested for moisture content over a period of 8-24 hours with the temperature cycled from 20 to 75°C and to 125°C. Adsorption and capillary condensation of moisture were found to increase with higher temperature above ambient, with higher ambient humidity and with longer exposure. Comminution of the sponge also results in more moisture adsorption. Reprocessing under optimum possible hygrothermal conditions will soften commercial titanium sponge in summer and reduce seasonal fluctuations of the metal quality indicators. References 5: 4 Russian, 1 Western.
[73-2415]

USSR UDC: 621.791.753.9:669.295

STABILITY OF TUNGSTEN ELECTRODES IN ARGON-ARC WELDING OF TITANIUM UNDER FLUX

Kiev AVTOMATICHESKAYA SVARKA in Russian No 10, Oct 79 pp 41-43, manuscript received 22 May 78

PRILUTSKIY, V. P., Engineer, IVANOVA, O. N., MECHEV, V. S., ZAMKOV, V. N., Candidates of Technical Sciences, Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences UkrSSR

[Abstract] An estimate is presented of the change in the shape of the end of the tungsten electrode as a function of the composition of the alloying additives, angle of turning of the electrode and length of the arc. A study was performed while surfacing VT1-0 titanium plates with electrodes consisting of tungsten rods 4 mm in diameter containing up to 1.5% of one of the oxides: Al_2O_3, Nd_2O_3, Dy_2O_3, La_2O_3, CeO_2, ThO_2, Y_2O_3, or Ti_2O_3. Turning angles were 30, 45, 60 and 90°. The influence of blunting was evaluated on the electrodes of all of the compositions studied with a turning angle of 45° and a blunting diameter of 0.5 mm. The electrode with Y_2O_3 was found to be superior for welding of titanium under flux. Figures 5; references 8: 5 Russian, 3 Western.
[44-6508]

USSR UDC: 621.791.011

WELDABILITY OF M40 ALUMINUM ALLOY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 10, Oct 79 pp 52-54, manuscript received 24 Oct 77; after revision 1 Mar 78

ISHCHENKO, A. YA., IGNAT'YEV, V. G., Candidates of Technical Sciences, CHAYUN, A. G., Engineer, Kiev, and ZAYTSEV, V. I., SKOROSPELOV, V. V., DRUZHININ, A. T., Engineers, Moscow

[Abstract] A study was made of the possibility of improving the weldability and increasing the strength of joints welded in M40 alloy by the use of improved methods of arc welding using tungsten electrodes and new additives. It was found that the danger of formation of hot cracks in the welded seam can be greatly reduced by the use of wire made of 01177 or 1201 alloy. Helium-arc welding with forward-polarity dc and plasma-arc welding with reverse-polarity dc, which have lower values of energy per unit length of seam, produced stronger seams. References 4: all Russian.
[44-6508]

USSR UDC: 621.791:62-419-478

SPECIFICS OF WELDING OF HONEYCOMB PANELS ON SPECIALIZED MACHINES

Moscow SVAROCHNOYE PROIZVODSTVE in Russian No 8, Aug 79 pp 13-15

GANIN, YU. K., SHORNIKOV, V. M., YANCHUK. L. M., Engineers

[Abstract] A description is presented of the processes involved in assembly and welding of honeycomb panels. Diagrams of the machines used are presented, plus a photograph of the microstructure of the metal at a spot weld. The honeycomb panels are assembled of strips of honeycomb filler which are welded both to each other and to the solid metal strips which form the sides of each honeycomb panel. Figures 5.
[45-6508]

USSR UDC: 621.791.72.01:620.192.4:669.14.018.8

SELECTION OF ENERGY PARAMETERS OF ELECTRON-BEAM WELDING IN ORDER TO REDUCE THE FORMATION OF HOT CRACKS NEAR THE SEAMS IN HEAT RESISTANT ALLOYS

Moscow SVAROCHNOYE PROIZVODSTVE in Russian No 8, Aug 79 pp. 3-6

MOROCHKO, V. P., Engineer, YAKUSHIN, B. F., Candidate of Technical Sciences, VERIGIN, A. M., Engineer

[Abstract] A study was made to determine the variation in strength in the zone around the welded seam of heat resistant metal welded by electron-beam welding methods as a function of the electron beam welding mode. The experiments were performed on type E1698 dispersion-hardened metal alloy with total content of aluminum and titanium of 3.61 and 3.96%, as well as type EP742 alloy with a total aluminum plus titanium content of 5.5%. The studies showed that the hot crack formation tendency is directly proportional to the heat content of the volume of melted metal in the welded bath per second. The best results were achieved by reducing this heat content by decreasing the welding speed. An alternate method is to decrease the area of melting. Another method such as angling the beam at 45° to the axis of the seam, increasing accelerator voltage, use of sharp focusing of the beam, optimal finishing of edges to be welded or alloying of the seam with pure molybdenum, vanadium or iron can also reduce the heat content of the bath volume per second. Figures 7; references 11: 7 Russian, 4 Western.
[45-6508]

USSR UDC: 621.791.753.9.019.001.2:669.71

INFLUENCE OF MOISTURE CONTENT OF PROTECTIVE GASES ON THE FORMATION OF PORES UPON WELDING OF ALUMINUM

Kiev AVTOMATICHESKAYA SVARKA in Russian No 10, Oct 79 pp 8-9, 26, manuscript received 17 May 78; after revision 13 Oct 78

PSARAS, G. G., Candidate of Technical Sciences ("Zhdanovtyazhmash" Production Union)

[Abstract] Results are presented from a study of the influence of the addition of dry hydrogen, as well as water vapor, to the argon used to weld aluminum with a fusible electrode on the formation of pours during welding. The test welds were made by surfacing plates of ADI alloy with SvA5 welding wire 2.5 mm in diameter with a welding current of 380-420 A, voltage 34-36 V, speed 12-14 m/hr, and protective gas flow rate 28-30 e/min. Before it was mixed with the argon, the hydrogen was passed through a solution of $K_2Cr_2O_7$, in concentrated sulfuric acid and through phosphorus pentoxide to remove moisture and other impurities. It was found that when the hydrogen content was increased to 15%, the same number of pores were formed as when no hydrogen was added to the argon. The argon was then moistened by passing it through a flask containing water. The results of the experiments are presented in the form of a mathematical model consisting of regression equations describing the interrelationship of the number of pores with the factor studied, namely: relative humidity of air around the arc, dew point of the protective gas and time of existence of the welding bath. Water vapor was found to cause intensive formation of pores in the seam metal. Figures 2; references 5: 3 Russian, 2 Western.
[44-6508]

USSR UDC: 621.791:669.620.192.47

BEHAVIOR OF DISSOLVED HYDROGEN IN THE PROCESS OF FRACTURE OF WELDED JOINTS IN HIGH-STRENGTH 01963 ALUMINUM ALLOY

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 79 pp 8-9

SUKHOVERKHOV, A. A., TALAYEV, V. S., engineers, DANILKIN, V. A., Candidate of Technical Sciences

[Abstract] A study was made of the behavior of dissolved diffusion-mobile hydrogen during heating of welded joints. The specimens were welded in one pass by argon-arc, plasma-arc and electron-beam methods in 01963 aluminum alloy plates 4 mm thick in modes designed to provide the maximum ductility. The experiments showed that the redistribution of dissolved hydrogen depends

on the ductility of the welded joint. The presence of a soft relaxing interlayer facilitates complete elimination of hydrogen segregations in the process of welding. Figures 1; references 12: 9 Russian, 3 Western.
[63-6508]

USSR UDC: 621.791.052.001.5:621.3.038.8

PROPERTIES OF WELDED JOINTS MADE WITH A HIGH POWER LASER BEAM

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 79 pp 13-15

SHMELEVA, I. A., GANTMAN, S. G., PAVLOVICH, A. A., SOKOLOVA, L. I., KOSYREV, F. K., MORYASHCHEV, S. F., FROMM, V. A., engineers

[Abstract] The purpose of this work was to establish the possibility of using a continuous powerful CO_2 laser beam to weld steel by through melting in various spatial positions. Welding was performed on plates of low-alloy steels, the chemical composition and mechanical properties of which are presented in tables. The plates were brought together with no gap and the edges were unfinished. No welding wire was used and the welding bath was protected by inert gas only on the beam input side. A two-mirror cassegrain lens system focussed the beam to 10° convergence. Plates 8-15 mm thick were welded with a beam power of 20 kw at 90 m/hr. Photomicrographs of the structure of welded seams and metal in the heated area are presented. Satisfactory mechanical characteristics were achieved, but some specimens had individual defects, particularly micropores or pores up to 0.1-0.2 mm in diameter. Figures 3; references 3: 2 Russian, 1 Western.
[63-6508]

USSR UDC: 621.791.01:536.2:620.178.3

THERMAL FATIGUE AND ENDURANCE OF WELDED JOINTS IN CHROME-NICKEL HEAT-RESISTANT ALLOY

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 79 pp 6-8

PRONINA, YE. M., Candidate of Technical Sciences, MASLOVA, N. D., FEDOROVA, G. V., engineers

[Abstract] A study was made of the effect of the following factors on the thermal fatigue and endurance of welded joints: initial structure of the base metal before welding; heat treatment before and after weldings; deformation during rolling of seams and preliminary drawing of specimens before

welding, imitating shape change as encountered in sheet parts; stress concentrators in the form of seams or scratches. The studies were performed on the KhN56VMTYu and Kh15M30VMT alloys, hardened by dispersion hardening. The properties of the welded joints were found to depend on heat treatment after welding: with proper heat treatment the joint metal and base metal had equal strength. If the initial structure of the base metal had large grains or if the seams were not properly smoothed and rolled, thermal fatigue and endurance of KhN56VMTYu alloy were reduced. Figures 4; references 5: all Russian.
[63-6508]

USSR UDC: 621.791.053:620.18:669.715

STRUCTURE AND PROPERTIES OF WELDED SEAMS OF ALUMINUM ALLOYS AS A FUNCTION OF CERTAIN WELDING TECHNOLOGY FACTORS

Moscow SVAROCHNOYE PROIZVODSTVE in Russian No 8, Aug 79 pp 28-29

SITYAVIN, YU. I., Engineer, TERMINASOV, YU. S.,(deceased) Doctor of Physical and Mathematical Sciences, and ZUBRIYENKO, G. L., Candidate of Technical Sciences

[Abstract] A study is presented of the relationship between parameters of the structure and properties of the metal of welded seams and technological factors which determine the amount of heat liberated. This study was performed on AMg6 and 1201 alloys 4 mm thick, welded by three methods: argon arc continuous welding; argon arc welding with electromagnetic movement; and argon arc welding with periodic feed of the welding wire. Decreasing the energy liberated decreases grain size in the structure and improves strength property. Figures 6; references 6: all Russian.
[45-6508]

USSR UDC: 621.791.4.001.5:539.378.3:620.179.16:669.295

STUDY OF THE POSSIBILITIES OF THE ULTRASONIC METHOD OF TESTING OF TITANIUM ALLOY JOINTS PRODUCED BY SOLID-PHASE WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 79 pp 30-32

AZAROV, N. T., MATYUSHKIN, B. A., LEVTOVA, K. A., Candidates of Technical Sciences, ARIYEVICH, G. E., ZAYTSEVA, L. D., Engineers

[Abstract] Defects in solid-phase welding (diffusion bonding) joints are classified in three groups according to the cross-sectional area and opening of the defect. The ability of ultrasonic testing methods to locate the two most dangerous types of defects was tested, and it was found that type DUK-66P series-produced ultrasonic apparatus can reliably find defects with areas of over 0.2 mm^2 and openings over 1 um in specimens 8-15 mm thick. Specimens 1.5-5 mm thick can be tested by ultrasonic equipment under water. Figures 6; references 2: 1 Russian, 1 Western.
[46-6508]

USSR UDC 621.791.4:539.378.3

PHYSICO-MECHANICAL PROPERTIES OF DIFFUSION-WELDED JOINTS BETWEEN THE VZhL12U ALLOY AND EI961 STEEL

Kiev AVTOMATICHESKAYA SVARKA in Russian No 11, Nov 79 pp 46-49 manuscript received 6 Dec 78

BORDAKOV, P. A., engineer, SAMORODOV, D.V., engineer, GRISHIN, I.S., engineer and PROKHOROV, A. A., engineer, Kuybyshev Institute of Aviation imeni S.P. Korolev

[Abstract] Turbine wheels made of the heat-resistant VZhL12U cast nickel alloy and shafts made of E1961 steel were joined by diffusion welding under vacuum. In order to produce joints of adequate mechanical strength close to that of the VZhL12U alloy, it was found necessary to add a 50-um-thick interlayer of technical-grade nickel. Subsequent metallographic examination of specimens after welding and mechanical tests at room temperature as well as at a typical service temperature of 500°C, according to a mathematically planned experiment, yielded data on static and fatigue strength of such joints as well as on the microstructure and the hardness profile of the transition zone. Annealing for several hours at temperatures from 110 to 1150°C under vacuum neither lowers the strength of such a joint nor reduces the barrier effect of the interlayer. This method of welding is, therefore, suitable for these materials. Figures 5; references 4: all Russian.
[72-2415]

USSR UDC 621.791.793

ON THE POSSIBILITY OF HARD FACING STEEL WITH TITANIUM NITRIDE

Kiev AVTOMATICHESKAYA SVARKA in Russian No 11, Nov 79 pp 71-72

SVETLOPOLYANSKIY, V. I., Candidate of Technical Sciences, DAN'KIN, A.A., Candidate of Technical Sciences, and ORESHKIN, V. D., Doctor of Technical Sciences

[Abstract] Titanium nitride is a refractory material with excellent mechanical characteristics such as hardness, heat and wear resistance, and chemical stability in acidic and alkaline solutions at high temperatures. It is not used for facing steel, however, because of its low thermal and electrical conductivity as well as poor wettability. A technological process making this possible has been developed at the Volgograd Institute of Construction Engineering. It is an electroslag welding process (I= 300-350 A at 20-30 V) with an electrode of refractory tungsten and with a special flux (AN20+ An349-A= 1:1). The first face layer is deposited with the current in the forward direction and, after trimming, the second layer is deposited with the current polarity reversed. The result is a nonporous nondefective face layer containing primary titanium nitride and eutectic solid solutions. The hardness and the wear rate of experimental steel (St 3) specimens were found to smoothly increase and decrease, respectively, with increasing TiN content in the slag mixture. Academician G.V. SAMSONOV (deceased), corresponding Member of the Academy of Sciences of the Ukrainian SSR, served as science consultant. Figures 3; references 1 Russian.
[72-2415]

USSR UDC 621.791.052.08:669.295

WELDING OF THE AT3 ALLOY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 11, Nov 79 p 76

BLASHCHUK, V. YE., engineer, FERBUNATOVA, A.N., engineer, and SHELENKOV, G.M., Candidate of Technical Sciences

[Abstract] The mechanical strength of the low-cost AT3 titanium alloy, containing an o -phase stabilizer (aluminum) and B-phase stabilizers (chromium, iron and silicon) but no scarce elements, is at 200°C twice as high as that of the VT1-0 alloy. It is being used increasingly for chemical industrial equipment. Rolled strip 8-35 mm thick was tested for weldability, in terms of tensile strength (GOST 6996-66) and impact strength (GOST 9454-60) in the seam and in the zone of thermal influence, at temperatures from 20 to 300°C. The joints were made with an argon arc and a tungsten electrode, with and without electromagnetic stirring. The welding was done automatically without separation of the edges and manually either with an X-form separation of edges or with a slit clearance between them. The results of measurements were found to be distributed normally. References 3 Russian.
[72-2415]

METALS FROM THE OCEAN

Tallin SOVETSKAYA ESTONIYA in Russian No 266, 22 Nov 79 p 3

[Article by B. Rozen, Senior Associate in the USSR Academy of Sciences: "Metallurgy of Neptune"]

[Text] On an express train from Moscow to Simferopol' an argument broke out between members of a scientific expedition being sent to the Crimea. The subject of the dispute was of obvious interest to them: how to correctly explain what seawater is.

First to speak was a geographer: "I would say it's the water that covers three-fourths (70.6 percent, to be precise) of the earth's surface."

"I would add," said a meteorologist, "that it is the primary heat-carrier of our planet's 'central heating system'. As we know, dry land heats up and cools down quickly. Seawater, on the other hand, cools down slowly. One cubic meter of seawater cooled five degrees heats upwards of 3,000 cubic meters of air."

"From my point of view," remarks a physician, "seawater is an excellent antibiotic. It kills staphylococci against which even penicillin is not effective. In fact, even doctors in ancient Greece and Rome, India and China placed high value on the curative power of seawater. Thousands of years ago, it was invariably recommended that patients bathe in seawater."

"And we think seawater is liquid ore," adds a metallurgist.

Upwards of 70 chemical elements have been found in sea and ocean water. Along with the metals in which the earth's crust is rich -- iron, copper, manganese, it contains salts of such rare metals as cesium, lithium and rubidium. There is also gold, uranium and radium.

Although the concentrations of a majority of the metals in seawater are infinitesimally small -- only hundredths or thousandths of a milligram per liter (0.12 for lithium and 0.0005 for cesium, for example) -- they are of commercial interest.

Seawater also contains metals in rather higher concentrations, including potassium and magnesium. Thus, one cubic meter of seawater contains 1,300 grams of magnesium.

Early in our century, only photographers and pyrotechnicians used magnesium. But even before World War I it was noted that metallic alloys of magnesium and other metals were lighter than steel and iron and were their equal in strength. Various automobile, airplane and helicopter parts are manufactured out of magnesium alloyed with lithium, beryllium and cobalt. Lithium-magnesium alloys have recommended themselves especially well. They are the lightest and most heat-resistant alloys. Such alloys are used in the manufacture of rockets and in building supersonic aircraft and space ships.

Heretofore, the main source of magnesium and its compounds has been such minerals as magnesite, carnallite and dolomite. However, seawater is increasingly more competitive with them with each passing year. In fact, the magnesium reserves in the world ocean are practically inexhaustible, about 2,200,000 billion tons.

The technology for extracting magnesium from seawater is very simple. Powerful pumps pump seawater to filters or it is brought to artificial basins by canal. Here, the water is continuously processed by milk of lime produced from sea lime obtained by roasting oyster shells.

The lime interacts with magnesium salts dissolved in the seawater. A thin magnesium oxide hydrate suspension forms and goes to a settling tank. Water is drawn out and the precipitate is dried on filters; it is neutralized by a chloride, concentrated in an evaporator, and finally dehydrated in driers. The magnesium chloride formed by interacting with the chloride undergoes electrolysis. The current breaks up the magnesium salt molecules and a layer of magnesium is deposited on the cathode. Metal billets weighing 7-8 kg are cast out of it.

Magnesium was first obtained from seawater in England in 1916. Eight years later, it was being extracted from the Dead Sea in Palestine. Now, there are already several dozen plants in the world extracting magnesium and magnesium compounds from seawater.

Upwards of 20 plants are in operation in the USA and Britain alone and meet all these countries' magnesium requirements. This valuable metal is also being extracted from seawater in other maritime countries -- Italy, France, Tunisia.

Currently, upwards of 40 percent of world magnesium production (excluding the USSR) comes from the sea.

In our country, the shallow Sivashskiy Bay in the Sea of Azov will soon become a major supplier of magnesium. Some 3.5-fold more magnesium oxide (and consequently metal as well) can be extracted per cubic meter of water here than from seawater in other places. Sivashskiy Bay salts are 16-17 percent magnesium salts.

Plans have already been drawn up for a magnesium plant to be part of a chemical combine which will be built in Sivash in the immediate future.

Another source of magnesium from seawater will in time be located on the Mangyshlak Peninsula. It has a large depression just 12 km from the shoreline which drops 100 meters below the level of the Caspian Sea. If a canal were to be dug in this depression and the water from the Caspian let into it, a sort of lake would gradually be formed in it; various salts, including those of magnesium, would accumulate on the bottom.

And so, maritime metallurgy is gathering strength a bit.

Back 35 years ago, the Japanese developed methods of extracting rare and valuable metals -- lithium, rubidium and cesium -- from salt sources (remaining after the sodium chloride was removed from salt basins). They are now being used widely in new equipment: automatics, television, rocketry and other fields. These metals are encountered rarely in the earth's crust, and are usually associated with other metals at that. Such ores must therefore be enriched, which is very expensive. But it is quite a bit cheaper to extract these metals from seawater.

The extraction of gold from seawater is of great interest. Specialists estimate that the seas and oceans contain about 10 million tons of gold (nearly 300 times as much as is in the earth's crust). However, it is not all that easy to extract it. In fact, one cubic meter of water contains only 0.00001 gram of gold. Scientists and inventors have been seeking profitable methods of extracting gold from seawater for more than 100 years now, but no such method has yet been found.

Approximately 20 years ago a Soviet chemist, A. V. Davankov, succeeded in extracting several grains of gold from seawater. He installed several large glass open-ended cylinders on the deck of the "Mikhail Lomonosov" expeditionary ship. Ionite (ion-exchange resin) granules were poured into them and the seawater passed through them. These marvelous plastic granules are able to selectively absorb various chemical elements and substances.

Davankov's catch was small, only one milligram of gold from 500 cubic meters of water, but it opened a new page in maritime gold-mining industry. There will come a time when commercial ships supplied with absorption columns will bring in gold and various rare metals when returning from a voyage.
[59-11052]

11052
CSO: 1842

METAL FOR THE NEW TECHNOLOGY

Moscow IZVESTIYA in Russian No 302 27 December 1979 p 2

/Article by President of the Ukrainian Academy of Sciences, Academician B. Paton: "Metal for the New Technology: Speeding Up the Introduction of Scientific-Technical Designs and Discoveries Into Production"/

/Text/ There is a precise quantitative indicator of how efficiently the system "science - technology - production" is functioning. This indicator is the time in which production is able to assimilate the achievements of fundamental and applied research. Today it is years rather than decades that separate many fundamental discoveries from their assimilation by industry. For example, from the time that a radio or electronic tube was discovered until it was assimilated more than 30 years had passed, but from the creation until the practical realization of solar batteries and lasers less than three years elapsed.

This is a regular and necessary tendency to reduce the time periods for assimilation. With the high dynamism of modern production forces the period of obsolescence of new equipment and technology does not exceed six to eight years. This is why it is now important to find and create forms of the tie between science and production that will substantially reduce the span of time between the birth of an idea and its practical application.

In the Ukrainian Academy of Sciences much attention is devoted to questions of the speeded-up utilization of the results of scientific research in the building of communism and to the search for new and the improvement of existing forms of the tie with production. The efforts of the scientific collectives of the republic are aimed at the further intensification and expansion of fundamental and applied research, at the creation on this basis of basically new technologies and at the rapid transfer of these new technologies to the national economy. During the past five-year period they created more than 300 new technologies of varied level and scope, which are being successfully used in the enterprises of ferrous metallurgy, chemical, ship building, aviation, gas, food and several other branches of industry. Recognition of the high quality of the technologies created in the Ukrainian Academy of Sciences is the sale of 42 licenses for them to industrially developed nations. We are proud that the Central Committee of the CPSU has approved this year the experience of the Ukrainian Academy of Sciences in creating new technologies on the basis of fundamental research and has outlined specific ways to develop and broadly disseminate the experience.

How is the system "science - technology - production" functioning in the republic? First of all we are constantly concerned about intensifying fundamental research. They are working for the future and are not governed rigidly by the requirements of the present. The success of this sector determines both the raising of production to a qualitatively new level and the successful advancement of the very front of science.

The following stage is also extremely important - the organization on the basis of fundamental research of applied and technological designs. Their purpose is to find the shortest and most rational ways and means to use in practice those laws of the objective world, which are acquainted with the fundamental sciences. In this link the foundation is laid and the general contours of the technology of the future are determined. It is here that information, which proceeds both from the fundamental sciences and production, is refined and reunited.

Institutes engaged in natural and technical sciences are directed toward the development of fundamental research and the creation on their basis of the latest technologies. When distributing money allocated for science, we seek to accomplish a program of financing that will to the greatest extent favor the development of progressive technologies. Funds from involved ministries and departments also come into play here. This speeds up the process of creation and, most important, the adoption of innovations and promotes the rapprochement of science and production.

The enterprises of the experimental-production base play an important role in creating the conditions for the development of fundamental research, in providing a high degree of completion of applied designs and in bringing them to the industrial level. We are firmly convinced that the use of this base makes it possible to truly develop fundamental science and with the greatest efficiency realize its achievements in new technologies.

The materials technology is being successfully developed at the academy. In the light of the measures planned by the Party and the government for improving the economic mechanism, this trend seems particularly important to us. The problems of materials and the organization of such leading branches as metallurgy and machine building are especially acute today.

The development of these branches is a very important government-wide task. After all they form the foundation of the economy. Circumstances are such in these branches that we are again and again forced to direct our attention to unresolved questions. Some figures are worth pondering again. In the

USSR 1.5 tons of steel are used to produce one ton of rolled product; in the USA this indicator amounts to 1.3 and in Japan it is 1.2. The structure of Soviet rolled product assortment suffers a serious shortcoming - the percentage of hot-rolled and cold-rolled sheet steel is very low.

The Soviet Union, birthplace of the continuous pouring of steel, unfortunately lags behind in the use of this progressive technology. Next year the percentage of steel poured by the continuous method will reach 10.8 percent in the USSR, while in Japan they have poured approximately 41 percent of all steel using this method.

Over a period of several years I have had to participate in the work of a specially created group of scientists and specialists, who each year are given the task of analyzing the status and plans for the further development of ferrous metallurgy. In our conclusions we have several times pointed out that questions concerning the production of pig iron, steel and rolled product must be viewed in close context with the problem of the consumption of metal, and not independently.

We must be concerned about the fact that over a period of the last ten years, for example, the coefficient of the use of rolled steel in machine building has stabilized at around .7 percent with no signs of its being lowered. Today the USSR is producing substantially less finished product from each ton of metal than the USA, Japan and West Germany. The reasons for this alarming situation are well known. On the one hand, it is connected with the unsatisfactory structure of the production of metal products, including nonferrous metallurgy (for example, the USSR clearly does not have enough rolled aluminum); on the other hand, it is connected with the sharp lagging of mill production in machine building. The amount of mechanical processing is still too great. In the last ten years the amount of shavings has increased nearly 1.5-fold and now exceeds eight million tons per year. At the same time the amount of forge and press processing, which is distinguished by significantly less losses of metal than in machine tool processing, is totally unsatisfactory. Each year there is an increase in the production of metal cutting tools, but at the same time we do not have enough forge and press equipment.

If the most energetic measures are not taken to radically improve the structure of mill production in machine building on the basis of the latest low waste and waste-free technologies, it will be difficult to solve the problem of meeting the needs of the national economy for metal.

It should also be pointed out that in developed capitalist nations from year to year the output of cast steel in relation to the production of rolled steel is steadily declining. In Italy, for example, over a fifteen year period from 1960 to 1974 the ratio of output of cast steel to rolled steel declined from 1.3 to .8 percent; in 1976 it amounted to .6 percent. Similar trends are characteristic for other nations, including the USA. In the USA, however, the structure of metal consumption is improving more slowly than in Japan and West Germany, for example. What is the USSR doing? Unfortunately, we have too great a percentage of cast steel, which leads to unjustifiably large losses of metal.

It should be noted that with the active participation of scientists there have already been designed basic trends for the further development of several crucial branches of the national economy, including the prospect for the development of ferrous metallurgy in the Soviet Union up to the year 1990. The trends call for the further improvement in the assortment of ferrous metals, raising their quality and consumption properties needed for the more complete and efficient use of metals. Such a path of development for the metallurgical production will make it possible to decrease the expenditure of metal at all stages of conversion and to reduce capital expenditures for the extraction of raw materials and fuel.

In the near future the industrial assimilation of several hundred new grades of steels and alloys will be accomplished. Particular attention is being given to the more progressive ways of producing steel that is smelted, in particular, in electroslag, vacuum-arc, vacuum-induction, electron-beam and plasma furnaces. Rolled metal from metal obtained by methods of special electrometallurgy is increasing approximately 3-fold.

It is time to intensively develop a direct reduction of iron from iron ore concentrates and its subsequent new conversions. The development of the industry for the direct reduction is made necessary by the present reduction of coking coals, the successes of mining and enrichment technology and several other reasons. The direct reduction method requires significantly fewer capital investments while simultaneously making it possible to obtain steel with a minimal content of harmful admixtures. It is necessary that the productivity of the installations of direct reduction reach the productivity of blast furnaces - 8 - 10 thousand tons of metalized raw materials in a 24-hour period - in the near future.

We continue to be slow in the practical application of powder metallurgy on a large scale. L. I. Brezhnev, speaking at the November (1979) Plenum of the Central Committee of the CPSU, stressed to those in attendance the need to more rapidly and boldly develop powder metallurgy, which can provide our national economy with a great deal.

Statistics show that the use of 1,000 tons of parts from powders in machine building frees from 2 to 2.5 thousand of rolled metal or castings, approximately 80 units of metal cutting machine tools and 190 workers. In cost terms approximately 1.5 million rubles are saved per 1,000 tons of manufactured articles.

Powder metallurgy methods create basically new materials for the atomic-powder machine building, for the cryogenic and space technology and for the technology of high pressures. The new machines, mechanisms and instruments that are manufactured from these materials can operate in extreme conditions. The use of steel powders, alloy powders and powders of infusible compounds for the population of wear-resistant covers and covers with special properties makes it possible to considerably increase the resistance of metal constructions, parts for machines and instruments, and to sharply reduce losses of metal. In the Ukrainian SSR Academy of Sciences a great deal of attention is being given to questions of powder metallurgy. The Institute of Problems of Material Science has become the Soviet leader in this field. It coordinates the work of 130 Soviet scientific-research organizations and industrial enterprises.

It is quite clear that the practical successes of metallurgy as an important governmental matter will largely depend upon the achievements of Soviet science, the drive to adopt the results of fundamental research into production and their embodiment in progressive technology processes and in new technology.

But the development of the metallurgical and machine building branches does not hinge solely upon the metallurgists. Long-range plans take this into consideration. Ahead is serious and difficult work in creating a new system of planning the production of metal products, which should be free of those serious shortcomings that hindered us previously. This includes, for example, criteria for rating produce output by weight or by cost. In all likelihood, as concerns estimating the actual consumer usefulness of product, it would be necessary to introduce such a planning indicator as the coefficient of the use of metal and the extent to which non-metallic materials replace steel.

All of these problems must be solved without delay in order to fulfill the decree of the Central Committee of the CPSU and USSR Council of Ministers "concerning the improvement of planning and strengthening the influence of the economic mechanism on raising production efficiency and the quality of work." This decree calls upon workers in science to rapidly implement in the national economy scientific-technical discoveries and designs intended to increase the growth rates of labor productivity and product quality. [58-8927]

8927
CSO: 1842

USSR

INVESTIGATION OF THE PHASE COMPOSITION OF SURFACE FILMS FORMED DURING ELECTROCHEMICAL TREATMENT OF MOLYBIDENUM, TITANIUM, ALUMINUM AND NICKEL

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 5, Sep-Oct 79
pp 29-31

KUDIMOV, YU.N., KRIVOBOKOV, YU.A. and MOSKALENKO, M.B., Novocherkassk

[Abstract] Surface films formed during electrochemical treatment of Mo4-1 molybdenum, VT1-0 titanium, A-5 aluminum, and NK-02 nickel foils were examined for phase composition. The treatment conditions were 20-30 A/cm^2 at 20-25°C, velocity of the electrolyte stream 10-15m/sec, interelectrode gap 0.1-0.5 mm. The following electrolytes were used: 25% $NaNO_3$ + 5% NaCl for molybdenum, 15% NaCl+ 2% KBr+ 2.5% KI+ 0.5% $NaNO_2$ for titanium, 15% $NaNO_3$ + 5% NaCl for aluminum, and 15% NaCl+ 2% Na_2HPO_4 for nickel. The analyses were performed with an EMR-100 electronograph operating in the reflection mode at an accelerating voltage of 75 kV, with an NaCl crystal for calibration. The oxides were found to be MoO_2, TiO_2 (rutile), Al_2O_3+ $Al(OH)_3$, and Ni+ $BNi_2O_3.H_2O$, respectively. Rinsing of the surface after treatment completely removed the electrolytic salts. On the basis of these and thermodynamic data, the possible reactions occurring at the surface at attainable anodic potentials and during subsequent desiccation are suggested. References 8: 5 Russian, 2 Western.
[62-2415]

USSR UDC 669.15

AMORPHIZATION OF METALLIC ALLOYS UNDER LASER ACTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 249, No 5, 1979 pp 1118-1120 manuscript received 27 Jun 79

KYASHKIN, V.V., ZHDANOV, G.S. and MIRKIN, L.I., Moscow State University imeni M.V. Lomonosov

[Abstract] Materials are generally stronger mechanically and more resistant to corrosion in the amorphous state than in the crystalline. Quenching a metal or alloy from a melt at rates within 10^6-10^{10} K/s will produce an amorphous structure, and a study was made concerning the feasibility of using a laser beam for this purpose. Accordingly, with a calorimetrically controlled neodymium pulse laser, binary Cu-Zr and Ni-Nb alloys were deposited from equiatomic powder mixtures on bulky Cu and Ni substrates, respectively. The microstructure of the alloys were examined by x-ray

diffractometry and microhardness tests. The results indicate that amorphization occurs only within a very narrow range of process conditions, even a 10-15% deviation from the optimum laser energy level already resulting in a crystalline structure. Amorphous structures produced by tightly controlled laser action were, furthermore, found to be much harder not only than structures of the component materials but also than amorphous alloy structures produced by quenching from the liquid state. The article was presented by academician N.V. BELOV on 13 June 1979. Figures 2; references 9: 5 Russian, 4 Western.
[60-2415]

USSR UDC 666.76.01+621.315.61+539.4

INVESTIGATION OF THE STRENGTH OF CERAMIC MATERIALS UNDER FORCE AND THERMAL ACTIONS. REPORT 1. YTTRIUM OXIDE

Kiev PROBLEMY PROCHNOSTI in Russian No 10, Oct 79 pp 46-50 manuscript received 7 Feb 79

GOGOTSI, G. A., ZAKHAROV, I. A., KUSHNIRENKO, A. M., and LUKIN, YE. S.
Kiev, Moscow, Institute Problems of Academy of Science and Moscow Chemical Technology Institute UkrSSR

[Abstract] Results are presented from investigations into the strength of yttrium oxide-base ceramics. After samples were produced by semi-dry pressing at 1000 kG/cm^2 they were heated at the rate of 200 degrees/min from initial temperatures of 20 and 800°C and tested for tensile strength, elasticity and deformability. Yttrium oxides were found to be less strong than aluminum and magnesium oxides but equal in deformability. All the yttrium oxides had the same magnitude of critical temperature drop where cracks of critical length are formed. It is only when a dense crack network forms from thermal loading that there is any loss in the modulus of elasticity. For thermally damaged samples there was no increased deformability associateed with subcritical crack growth and no increase in crack depth. The technology of producing yttrium oxide ceramics has no effect on the features of failure and there refractories are well suited for use as electric insulating materials. Figures 5; references 8: 6 Russian, 2 Western.
[57-6368]

USSR UDC 620.186.4:669.245:539.27

DEVELOPMENT OF DISLOCATION STRUCTURE IN THE PROCESS OF CREEP OF HEAT-RESISTANT NICKEL ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 79 pp 35-39

TRAVINA, N. T., NIKITIN, A. A., and ZIMINA, L. N., Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin

[Abstract] Heat-resistant nickel alloys EP202 (Kh67MVTYu) and EI661 (KhN60-MKVYu) were used to study dislocation structure and movement in the different stages of creep. Both alloys were homogenized at 1175°C for six hours, air cooled and aged: EP202 at 850°C, 15 hours, and EI661--at 1000°C, four hours,+ 900°C, six hours, +850°C, 10 hours. EI661 passed through stages of creep when subjected to tensile testing at 850°C. The first stage of creep had the slowest rate and the second stage the fastest. The second stage revealed changes in the intercrystalline structure. The creep rate remained the same in the second stage for high-temperature nickel alloys if they contained a moderate amount of strengthening phase, uniformly distributed in the matrix. In this case deformation was accomplished by the gradual propagation of unit dislocations leading to crystallographic slip. In alloys with a large amount of strengthening phase, creating fields of elastic distortions, the development of plastic deformation occurred nonuniformly and the second stage of creep had several sections with a constant but differing rate of deformation. In EI661 the slow creep rate in the first stage was caused by dislocations fastening themselves around the strengthening phase particles. The accelerated rate in the second stage was caused by an increased mobile dislocation density. Creep rate in the third stage was the result of dislocation propagation preventing coalescence of the alpha'-particles into plates. Figures 1; references 7: 6 Russian, 1 Western. [55-6368]

USSR UDC 669.27'298:669.018

INTERACTION OF THORIATED TUNGSTEN AT 1200-1600°C WITH DIFFERENT METAL MATRICES

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 79 pp 12-15

MIROTVORSKIY, V. S. and OL'SHEVSKIY, A. A.

[Abstract] A study was made of the interaction of 0.5-mm-diameter VT7 tungsten alloy fibers with Fe, Ni, Co, Ti and Cr binary alloys alloyed with 5, 10 and 25 mass % of one of the elements listed above or with Al, Cu, Si, Zr, Nb, Mo or W. Annealing of the composites was done at 1200-1600°C

for one hour. For an Fe-base alloy annealed at 1200-1400°C the fiber/matrix interaction increased sharply, the fiber recrystallized, and a thick layer (12-15 microns) of hard and brittle intermetallides formed at the fiber/matrix interface. Fe alloyed with 5-25% Al annealed at 1300°C for one hour or Fe alloyed with Si, Ti, Zr, Nb, Cr, Mo or W annealed at 1200°C for one hour did not lead to the formation of an interaction zone. A large portion of the binary alloys did not have recrystallized fibers after treatment at 1200-1300°C. Fe, Cr, Co and Ti are recommended for use as the base material for heat-resistant composites operating at 1300°C since these elements diminish recrystallization and dissolution of the fiber without significant loss of strength. Cr-base composites can be used at 1400°C and Ti-base composites at 1500°C. References 6: all Russian.
[55-6368]

USSR UDC 620.17:669.295+669.14

CONTACT PHENOMENA AND THEIR EFFECT ON THE STRENGTH OF TITANIUM-STEEL JOINTS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 79 pp 8-11

KRISHTAL, M. A. and KOZLOV, V. F.

[Abstract] The nature and properties of phases in the boundary zone and their effect on the strength of Ti-steel joints were studied using 22 bimetallic pairs of iron-carbon alloys containing 0.004-0.45% C with alloys VT1-1, Ti-6% Al-4% V and Ti-6% Al-4% V -6% Zr as well as pairs with a sublayer of dynamo steel E13. The bimetals were produced by rolling three- and four-layer packets at 850-1050°C and then annealing them in a vacuum at 600-1150°C with soaking for 150 hours. When the carbon content in the steel was 0.1-0.4% and rapid heating was done (250°/min) the beta + TiFe liquid-phase eutectic was formed due to the simultaneous supersaturation of the beta-Ti with iron and precipitation of TiFe. A significant amount of heat was also liberated and the bimetal volume shrank slightly with the formation and relaxation of stresses. The optimum annealing mode for steel 20K + E13 (sublayer) and titanium alloys was 850° for three hours which yields a bimetal strength of 15-15.5 kgf/mm^2 and a bend angle of 180°. Figures 4; references 16: 11 Russian, 5 Western.
[55-6368]

USSR UDC: 669.28

A STUDY OF THE PROPERTIES OF A NICKEL EUTECTIC ALLOY PRODUCED BY DIRECTED CRYSTALLIZATION WITH MOLYBDENUM, ALUMINUM AND CHROMIUM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov/Dec 79, pp 121-124, manuscript received 21 Apr 79

NESTEROVICH, L. N., KUPCHENKO, G. V., IVANOV, N. P., Minsk

[Abstract] Directed crystallization of alloys was performed by the Bridgeman method at 1-4 cm/hr. The mechanical properties of an alloy containing 35 vol.% molybdenum fibers were determined at 900-1100°C using 5-mm-diameter specimens. The short-term tensile strength of the eutectic was 40-45 kgf/mm^2 at 1100°C. The alloy also had good ductility. Relative elongation at 1100°C was 20%, necking down - 48%. The 100-hour strength of the alloy at 900°C was 22-23 kgf/mm^2, 11-12 kgf/mm^2 at 1000°C. When some of the Mo in the alloy was replaced with Cr these excellent physical properties were retained and oxidation resistance at high temperatures was improved. Figures 4; references 3: all Russian.
[64-6508]

USSR UDC: 535.211

PRODUCTION OF SIMPLE ANALYTIC EQUATIONS DESCRIBING THE PROCESS OF HEATING OF METALS BY CONCENTRATED ENERGY SOURCES

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov/Dec 79, pp 3-11, manuscript received 18 Jun 79

RYKALIN, N. N., UGLOV, A. A., SMUROV, I. YU., LOBANOV, V. S., Moscow

[Abstract] A study was made of the heating of metal by concentrated energy fluxes distributed normally. Such fluxes included laser beams, electron beams and relatively low accelerator voltages, gas flames, ion beams, etc. The radiation pulse was considered rectangular, the heated body - semiunlimited. Phase transitions and heat loss from the surface were not studied. This made the solution of the problem simple by the method of sources or by integral transforms; however, the solution was then expressed as an integral which cannot be written in elementary functions, making it difficult to use in practice. The authors developed a method to produce simple approximate analytic expressions in place of this integral, and analyzed the equations thus produced. The method is applicable to other problems, as well, such as the heating of metal by moving heat sources, heating with different shapes or radiation pulses, heating by 3-dimensional heat sources, etc. Figures 4; references 12: all Russian.
[64-6508]

USSR UDC: 539.4.0193:669.292

BLISTERING OF OKh16N15M3B STEEL UPON BOMBARDMENT WITH He^+ IONS AT $E = 0.3-1.8$ MeV

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov/Dec 79, pp 29-32, manuscript received 20 Feb 79

TOLSTOLUTSKAYA, G. D., PIVOVAR, L. I., GUSEV, V. A., NEKLYUDOV, I. M., KHAR'KOV

[Abstract] The variation in blistering parameters (type and shape, surface density and diameter of blisters, thickness of covers) as a function of bombardment conditions and conditions of subsequent annealing of specimens was determined for bombardment of type OKh16N15M3B steel, as delivered and after vacuum remelting. A scanning electron microscope was used to study the surface of the specimens. The experimental values of thickness and area of the separated surface layer were used to calculate the erosion factors for the steel bombarded with helium ions at from 0.3-1.8 MeV. The coefficient varied from 0.4 to 2.0 at/ion. Figures 3; references 9: 4 Russian, 5 Western.
[64-6508]

USSR UDC: 533.9:541.124-16

REDUCTION, EVAPORATION AND MELTING OF MATERIALS IN A STREAM OF GLOWING GAS (PLASMA)

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov/Dec 79, pp 48-51, manuscript received 20 Apr 79

NOVIKOV, V. S., Kiev

[Abstract] The study was made in a channel whose walls were made of a machined material. A steady flow of a radiating gas (plasma) containing a reducing gas flowed through the channel. The gas diffused from the flow to the walls and reduced them. At high temperatures, the reaction occurred in the diffusion area. The problem of melting of the body was studied as a function of heat exchange between the gas flow and the surface, and also the intensity of the process of melting. This approach to analysis of the interactions between a radiating gas and the walls of a channel can also be used for analysis or processes in the melting zone of a blast furnace. References 2: both Russian.
[64-6508]

USSR UDC 669.24'26'25:669.094.3

EFFECT OF MOLYBDENUM, TITANIUM, YTTRIUM, AND RARE EARTH METALS ON THE OXIDATION PROCESS IN Ni-Cr-Co ALLOYS

Moscow IAN SSSR, METALLY in Russian No 6, 1979 pp 212-217 manuscript received 16 Jun 78

LAZAREV, E. M., SAMARINA, A. M., KOROTKOV, N. A. and LEVANOV, V. I., Moscow

[Abstract] Ni-base alloys containing 15% Cr + 12% Co were experimentally treated with 1% Mo, 2% Ti, 0.1-1.0% Y, 0.1-0.5% La, 0.2% Nd, 0.2% Sm, and thereupon their oxidation kinetics was investigated by plotting kinetic curves as a function of periodic weighing of the specimens. Treatment with Mo as well as jointly with Mo and Ti was found to enhance the high-temperature strength of these alloys (change in weight of specimens after 100 hr of oxidation decreased by a factor of 3.4) Treatment with minute amounts (up to 0.05%) of r.e.m. had virtually no effect on the high-temperature strength of the alloys, but on the other hand it markedly enhanced the strength of adhesion (oxide film), thus preventing scale spallation between scale and metal. In terms of their effect on strength of adhesion between scale and metal, the r.e.m., when added in equiatomic quantities (0.08 at%) follow the sequence of increase in their atomic numbers. The greatest effect is produced by treatment with samarium. These findings are of interest to the development of permanent composite metal-porcelain stomatological prostheses. Figures 4; references 12: 5 Russian, 7 Western. [70-1386]

USSR UDC 669.017:537.32

ELECTROPHYSICAL PROPERTIES OF Zr-Ti AND Zr-Hf ALLOYS

Moscow IAN SSSR, METALLY in Russian No 6, 1979 pp 195-199 manuscript received 16 Oct 78

SAVIN, V.I., LESNAYA, M. I. and OVDEY, V. N., Kherson

[Abstract] The concentration dependence of magnetic susceptibility, Hall coefficient R, resistivity o, and thermo-emf oc-alloys of Zr-Ti and Zr-Hf were investigated, as were their o and within the 100-1300°K temperature range. For both types of alloys the concentration dependences of lattice periods and physical properties were characteristic of systems with complete mutual solubility. Zr-Hf alloys displayed an additive change in . The differing polarities of R and in Zr-Ti alloys as well as the pattern of the concentration dependences of R and for Zr-Hf alloys correspond to a mixed electron-hole nature of condution. The change in R and in the Zr-Ti alloy with increase in content of the second constituent--whether Zr or

Ti--corresponds to an increase in the contribution of electrons to the transfer process. The temperature dependences of o and within the 100-1300°K range display a number of anomalies which may be assoicated with an increase in the overlap between the Brillouin zone and the Fermi surface. Figures 4; references 11: 5 Russian, 6 Western.
[70-1386]

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